**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

TELECOM NETWORK SOLUTIONS, LLC,	§	
	§	
Plaintiff,	§	
	§	Case No. 2:21-cv-00415
v.	§	
	§	**JURY TRIAL DEMANDED**
AT&T INC., AT&T CORP., AT&T	§	
COMMUNICATIONS LLC, AT&T MOBILITY	§	
LLC, AT&T MOBILITY II LLC, and AT&T	§	
SERVICES INC.	§	
	§	
Defendants.	§	
	§	

COMPLAINT FOR PATENT INFRINGEMENT

Telecom Network Solutions, LLC ("TNS" or "Plaintiff") hereby submits this Complaint for patent infringement against Defendants AT&T Inc., AT&T Corp., AT&T Communications LLC, AT&T Mobility LLC, AT&T Mobility II LLC and AT&T Services Inc. (collectively, "AT&T" or "Defendants") and states as follows:

THE PARTIES

1.   TNS is a Texas limited liability company with a principal place of business at 3701 Kirby Dr., Suite 1000, Houston, Texas 77098.

2.   On information and belief, AT&T Inc. is a corporation organized and existing under the laws of the state of Delaware, with a principal place of business at 208 South Akard Street, Dallas, Texas 75202. On information and belief, AT&T Inc. may be served through its registered agent, CT Corporation System, 1999 Bryan St., Suite 900, Dallas, TX 75201.

3.   On information and belief, AT&T Corp. is a corporation organized and existing under the laws of the state of New York, with its principal place of business at One AT&T Way, Bedminster, New Jersey, 07921. On information and belief, AT&T Corp. may be served through its registered agent for service, CT Corporation System, 28 Liberty Street, New York, NY 10005. On information and belief, AT&T Corp. is a wholly owned subsidiary of AT&T Inc.

4.   On information and belief, AT&T Communications LLC is a limited liability company organized and existing under the laws of the state of Delaware, with a principal place of business at 208 South Akard Street, Dallas, Texas 75202. On information and belief, AT&T Communications LLC may be served through its registered agent for service, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801. On information and belief, AT&T Communications LLC is a wholly owned subsidiary of AT&T Inc.

5.   On information and belief, AT&T Mobility LLC is a limited liability company organized and existing under the laws of the state of Delaware, with a principal place of business at 1025 Lenox Park Boulevard NE, Atlanta, Georgia 30319. On information and belief, AT&T Mobility LLC may be served through its registered agent for service, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801. On information and belief, AT&T Mobility LLC is a direct or an indirect subsidiary of AT&T Inc.

6.   On information and belief, AT&T Mobility II LLC is a limited liability company organized and existing under the laws of the state of Delaware, with a principal place of business at 1025 Lenox Park Boulevard NE, Atlanta, Georgia 30319. On information and belief, AT&T Mobility II LLC may be served through its registered agent for service, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801. On information and belief, AT&T Mobility II LLC is a direct or an indirect subsidiary of AT&T Inc.

7.   On information and belief AT&T Services Inc. is a corporation organized and existing under the laws of the state of Delaware, with a principal place of business at 208 South Akard Street, Dallas, Texas 75202. On information and belief, AT&T Services Inc. may be served through its registered agent for service, The Corporation Trust Company, 1209 Orange Street, Wilmington, DE 19801. On information and belief, AT&T Services Inc. is owned by AT&T Inc.

8.   AT&T operates one or more wireless telecommunications networks to provide wireless telecommunications services in the United States under brand names including, but not limited to, "AT&T." The AT&T network has been and is used to also provide wireless telecommunications services for the "Cricket Wireless" brand.

NATURE OF THE ACTION

9.   This is a civil action for infringement of U.S. Patent No. RE47,813 (the "'813 Patent"), arising under the patent laws of the United States, 35 U.S.C. § 1 *et seq*.

JURISDICTION AND VENUE

10.   This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a) because this action arises under the patent laws of the United States, 35 U.S.C. §§ 101 *et seq*.

11.   On information and belief, AT&T's operations in the Eastern District of Texas are substantial and varied.

12.   AT&T operates one or more wireless telecommunications networks to provide wireless telecommunications services in Texas, including within the Eastern District of Texas.

13.   AT&T advertises that its 4G LTE, 5G and 5G+ wireless networks (collectively, "AT&T Network") are available in the United States including in Texas and within the Eastern District of Texas.[1]

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[1] *See, e.g.,* https://www.att.com/maps/wireless-coverage.html (last visited Oct. 11, 2021).
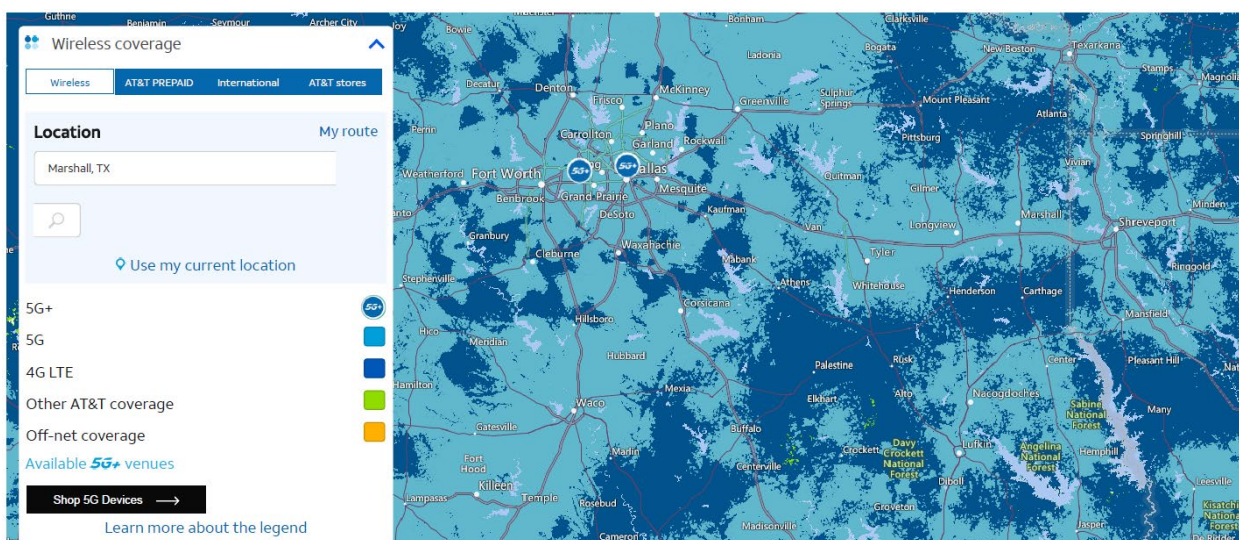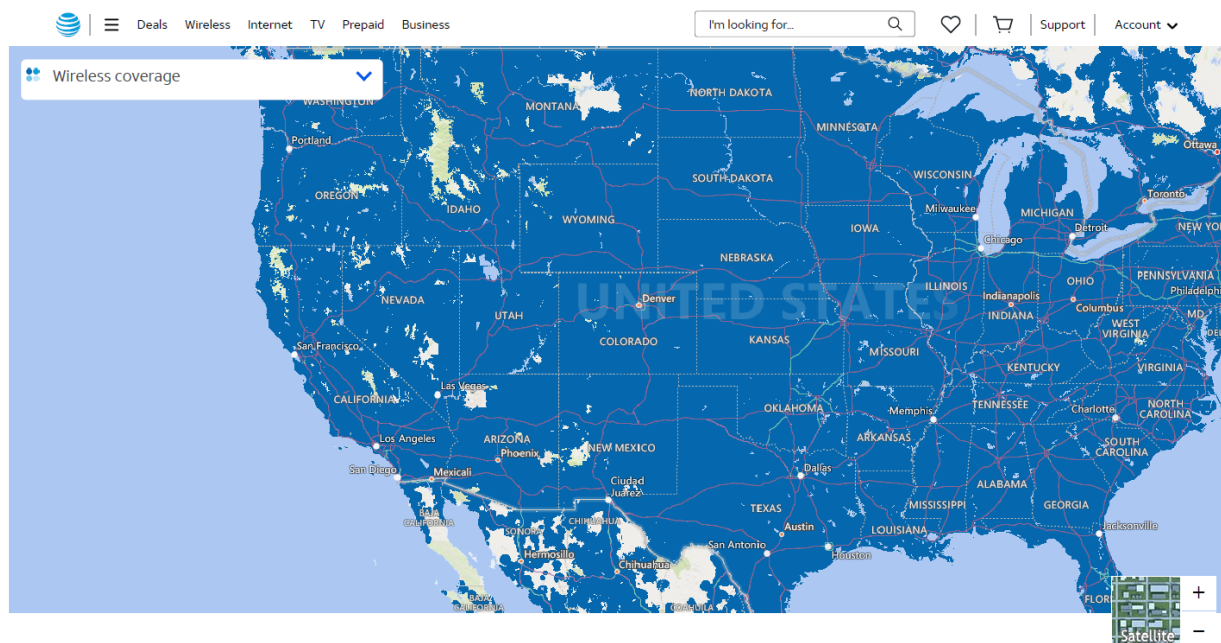
15.   For example, there are numerous AT&T retail stores within this judicial district, including in Allen, Athens, Beaumont, Canton, Denton, Frisco, Kilgore, Lindale, Longview, Marshall, Nacogdoches, Sulphur Springs, Texarkana, and Tyler.[2] AT&T uses these stores to sell

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[2] *See, e.g.,* https://www.att.com/stores (last visited Oct. 11, 2021).

telecommunications services that utilize the AT&T Network and that infringe the '813 Patent (discussed below). These stores are physical places within the district, are regular and established places of business, and are AT&T's places.

16.   AT&T also maintains a foundry within this judicial district at 2900 W Plano Pkwy, Plano, TX 75075. The AT&T foundry is a "physical space encompassing all aspects of an industry environment – from manufacturing to distribution to retail" and allows for "customer co-creation to [AT&T's] vertical customers" with respect to various technologies including, for example, "5G, artificial intelligence (AI), software-defined networking (SDN), and the Internet of Things (IoT) to drive their industry-specific digital transformation needs."[3] On information and belief, this AT&T foundry is used to design, test, use, promote, and sell AT&T telecommunication services including those accused of infringement in this action. The AT&T foundry is a physical place within the district, is a regular and established place of business, and is AT&T's place.

17.   On information and belief, AT&T has employees who work in the State of Texas and in this judicial district.

18.   AT&T has solicited business in the State of Texas, transacted business within the State of Texas and attempted to derive financial benefit from residents of the State of Texas, including benefits directly related to the instant patent infringement cause of action set forth herein.

19.   AT&T has manufactured, used, sold, and/or offered for sale the AT&T Network in the State of Texas and this judicial district.

20.   At the time of filing of this Complaint, the AT&T Network is available to consumers in Texas, including within this judicial district.

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[3] *See, e.g.,* https://about.att.com/story/2018/plano_foundry.html (last visited Oct. 11, 2021).

21.   The AT&T Network which is available in this judicial district is accused of infringement in this Complaint.

22.   AT&T derives benefits from its presence in this federal judicial district, including, but not limited to, sales revenue. For example, AT&T receives revenue from its corporate stores in this district, by selling network access, products (e.g., phones, tablets, smart watches, etc.), and services and by receiving payment for its network access, products, and services.

23.   AT&T's commission of acts of infringement, and the presence of AT&T retail stores and foundry in the Eastern District of Texas, establishes venue over it under 28 U.S.C. § 1400(b). *See, e.g.*, *Intellectual Ventures II LLC v. FedEx Corp.*, No. 16-cv-980-JRG, 2017 WL 5630023, at *6-*7 (E.D. Tex. Nov. 22, 2017) (Gilstrap, J.) (venue proper based on defendants' "physical retail and service locations").

24.   In other recent actions, AT&T has either admitted or not contested that this federal judicial district is a proper venue for patent infringement actions against it. *See, e.g.,* Answer, at 3, ¶14, *Kaifi, LLC v. AT&T Corp. et al.*, No. 2:19-cv-00138 (E.D. Tex. July 08, 2019), ECF No. 17; Answer at 2, ¶ 6, *Ramrod Licensing LLC v. AT&T Mobility LLC.*, No. 2:21-cv-00117 (E.D. Tex. July 08, 2021), ECF No. 21; Answer at 2, 3, ¶6, *Finesse Wireless LLC v. AT&T Mobility LLC*, No. 2:21-cv-00063 (E.D. Tex. May 04, 2021), ECF No. 24; Answer at 2, 3, ¶6, *Finesse Wireless LLC v. AT&T Mobility LLC,* No. 2:21-cv-00316 (E.D. Tex. Sep. 03, 2021), ECF No. 14.

25.   Venue as to AT&T is proper in this judicial district under 28 U.S.C. §§1391(b)-(c) and 1400(b) at least because AT&T has committed acts of infringement in this judicial district and has a regular and established place of business in this judicial district. Each Defendant makes, uses, sells, offers to sell, and/or imports products and/or services accused of infringement in this case into and/or within this judicial district and maintains a permanent and/or continuing presence

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within this judicial district. On information and belief, each Defendant has transacted and, at the time of the filing of the Complaint, is continuing to transact business within this judicial district.

26.   AT&T is subject to personal jurisdiction under the provisions of the Texas Long Arm Statute, TX CIV. PRAC. & REM CODE § 17.041 et seq., by virtue of the fact that, upon information and belief, AT&T has availed itself of the privilege of conducting and soliciting business within this State, including engaging in at least some of the infringing activities in this State, as well as by others acting as AT&T's agents and/or representatives, such that it would be reasonable for this Court to exercise jurisdiction consistent with principles underlying the U.S. Constitution, and the exercise of jurisdiction by this Court would not offend traditional notions of fair play and substantial justice.

27.   On information and belief, AT&T has also established minimum contacts with this judicial district and regularly transacts and does business within this district, including advertising, promoting and selling products and/or services in its stores, over the internet, through intermediaries, representatives and/or agents located within this judicial district, that infringe the asserted patents. On further information and belief, AT&T has purposefully directed activities at citizens of this State including those located within this judicial district. On information and belief, AT&T derives substantial revenue from the goods and services it provides to individuals in the state of Texas and in this judicial district.

28.   On information and belief, AT&T has purposefully and voluntarily placed its products and/or services into the stream of commerce with the expectation that they will be purchased and used by customers located in the State of Texas and the Eastern District of Texas. On information and belief, AT&T's customers in the Eastern District of Texas have purchased and used and continue to purchase and use AT&T's products and/or services.

29.   Defendants are properly joined under 35 U.S.C. § 299(a)(1) because, as set forth in greater detail below, on information and belief, Defendants commonly and/or jointly make, use, sell, offer to sell, and/or import infringing instrumentalities, such that at least one right to relief is asserted against Defendants jointly, severally, and in the alternative with respect to the same transactions, occurrences, or series of transactions or occurrences relating to the making, using, selling, offering to sell, and/or importing into the United States the same accused instrumentalities, as set forth in greater detail herein.

30.   Defendants are properly joined under 35 U.S.C. § 299(a)(2) because, as set forth in greater detail below, on information and belief, Defendants make, use, sell, offer to sell in, and/or import into the United States the same or similar accused instrumentalities, such that questions of fact that are common to all Defendants will arise in this action.

BACKGROUND

31.   AT&T provides wireless telephony and data services to customers throughout the United States, including in the State of Texas and in this judicial district under the AT&T brand. The AT&T wireless services are provided by a wireless network comprising, in part, cellular base stations for communication with mobile wireless devices over radio frequencies. These cellular base stations are located in this judicial district and throughout the United States.

32.   The AT&T Network, including the cellular base stations, communicates with customers' mobile devices (also referred to as "terminals" or "user equipment"), such as mobile phones, smartphones, tablets, and mobile hotspots, in accordance with fourth generation

("4G")/fourth generation Long Term Evolution ("4G LTE"), and fifth generation ("5G") mobile

network standards.[4]
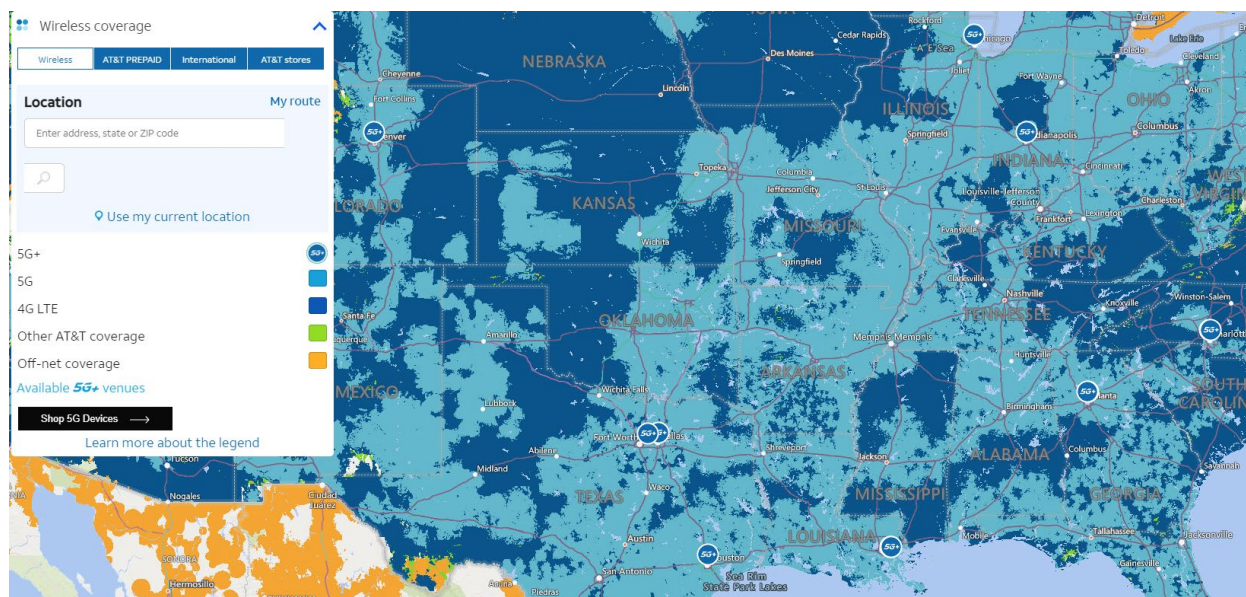
33.   AT&T also sells mobile devices, through channels including its website and retail

stores, that communicate using the AT&T Network in accordance with those 4G/4G LTE, and 5G

standards for use on its network.

34.   The AT&T Network includes a 5G and 5G+ (collectively, "5G") as well as 4G/4G

LTE mobile network.

35.   The AT&T 5G networks "covers 230M Americans in 14,000 cities and towns and

AT&T 5G+ is now available in parts of 38 cities in the U.S."[5]

36.   On information and belief, AT&T provides more than 100 million U.S. consumers

with communications and entertainment experiences across mobile and broadband. [6] It also serves

nearly 3 million business customers — including nearly all of the Fortune 1000 — with high-

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[4]   *See, e.g.,*   https://www.att.com/maps/wireless-coverage.html   (last   visited   Oct.   13,   2021);
https://www.att.com/support/article/wireless/KM1008740/   (last   visited   Oct.   13,   2021);
https://about.att.com/story/2021/5g_strategy.html (last visited Oct. 13, 2021).
[5] *See* https://about.att.com/story/2021/5g_strategy.html (last visited Oct. 13, 2021).
[6] *See, e.g.,* https://investors.att.com/investor-profile (last visited Oct. 13, 2021).

speed, highly secure connectivity and smart solutions.[7] "AT&T Communications" generated 2020
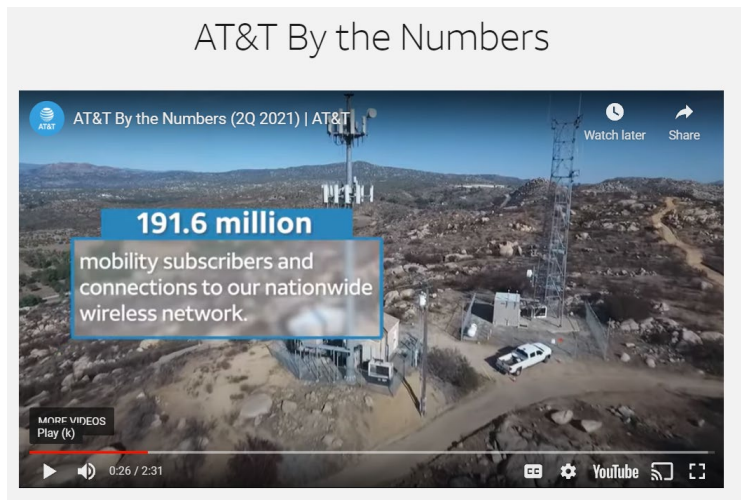
revenues of $110 billion.[8]
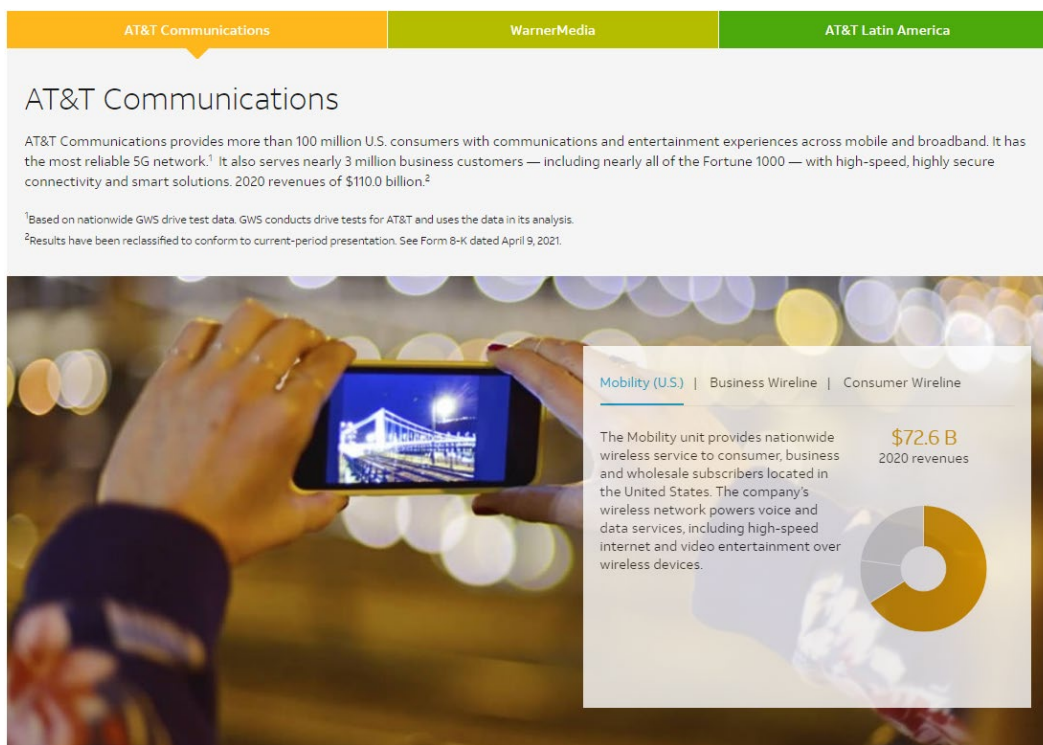
37.   On information and belief, more than 99% of Americans are covered by AT&T and

AT&T has nearly 192 million mobility subscribers and connections to its nationwide wireless

network."[9] There are more than 47 million connected cars on the AT&T network.[10]

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[7] *See, e.g.,* https://investors.att.com/investor-profile (last visited Oct. 13, 2021).
[8] *See, e.g.,* https://investors.att.com/investor-profile (last visited Oct. 13, 2021).
[9] *See, e.g.,* https://investors.att.com/investor-profile (last visited Oct. 13, 2021).
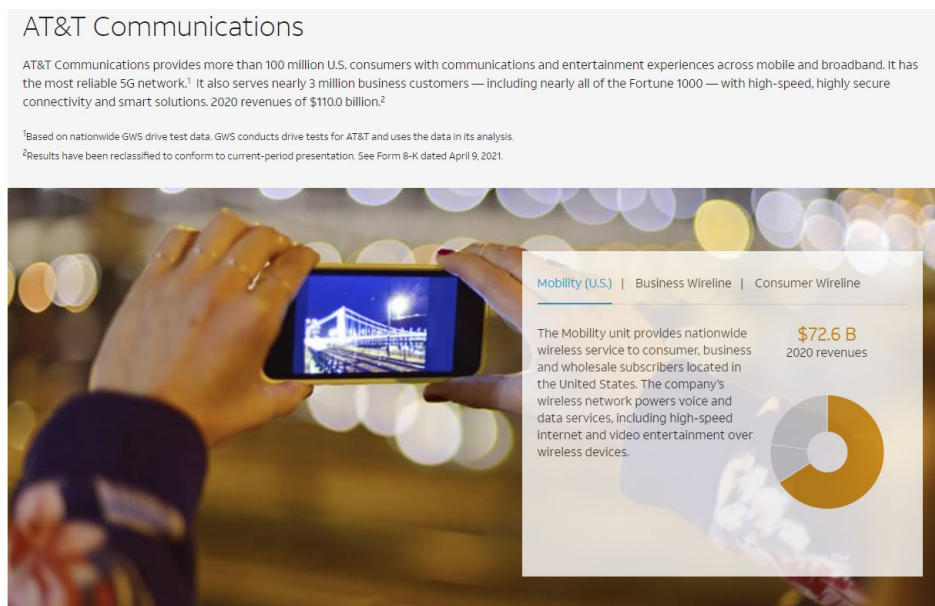[10] *Id.*

38.   The AT&T "Mobility unit provides nationwide wireless service" and the company's "wireless network powers voice and data services, including high-speed internet and
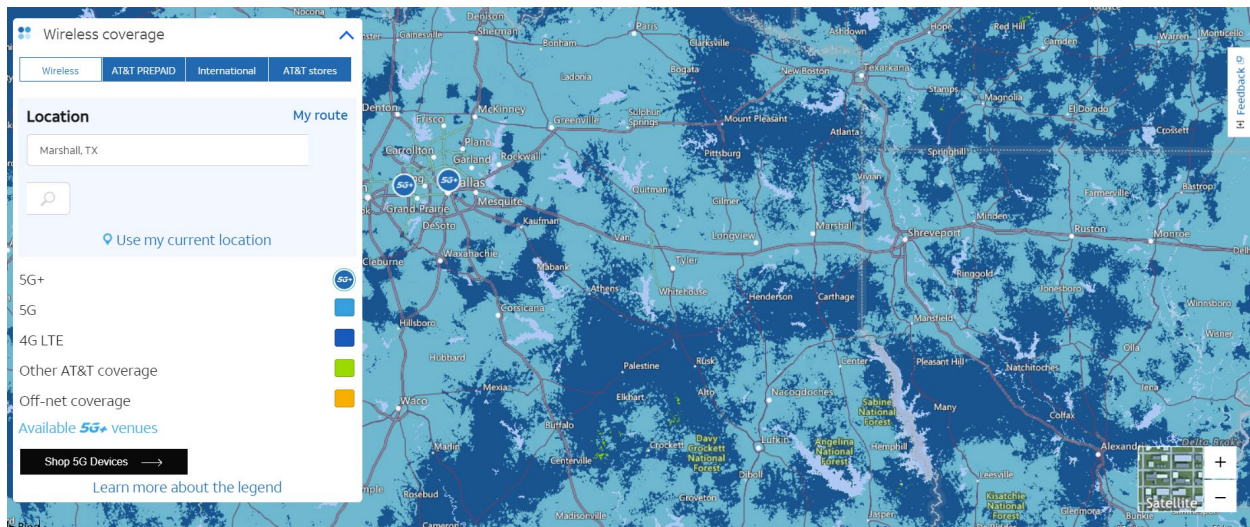
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video entertainment over wireless devices" and generated revenues in excess of $72 billion in

2020.[11]

39.   According to the interactive map available on the AT&T website (reproduced

below), a majority of the cities in this district have 4G LTE and/or 5G coverage on the AT&T

Network. For instance, the cities in this district identified with such coverage on the AT&T

Network include Marshall, Plano, Tyler, Nacogdoches, Texarkana and Longview.[12]

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[11] *See, e.g.,* https://investors.att.com/investor-profile (last visited Oct. 14, 2021).
[12] https://www.att.com/maps/wireless-coverage.html (last visited Oct. 13, 2021).

40.   AT&T encourages prospective customers and visitors to its website to sign up for

the AT&T Network claiming, for instance, that its network is "America's best 5G network."[13]
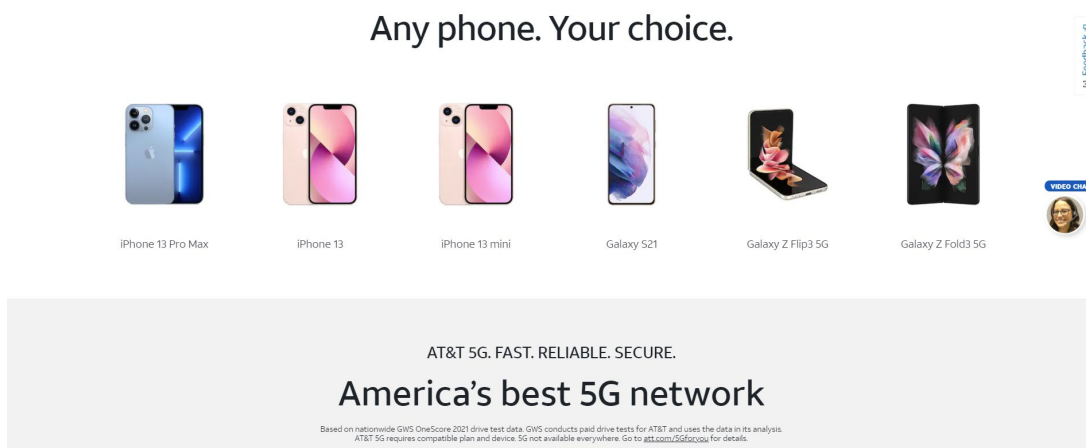
41.   The   AT&T   website   provides   "information   about   the   network   practices,

performance characteristics, and commercial terms applicable to [its] mass market wired, mobile

and Wi-Fi broadband internet access services."[14] The information provided by AT&T is meant to

"help customers make informed choices about how to use those services, and [] assist providers of

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[13] https://www.att.com/wireless/ (last visited Oct. 13, 2021).
[14] https://about.att.com/sites/broadband (last visited Oct. 14, 2021).

internet applications, content and services in developing, marketing and maintaining their internet

offerings."[15]

> At AT&T, we want our customers to have information to more fully understand and enjoy the services we offer. To help keep customers informed about our mass market broadband internet access services, the AT&T website (**www.att.com (https://www.att.com/)**) describes the mass market wireless and wired broadband internet access services we offer. In this document, we provide information about the network practices, performance characteristics, and commercial terms applicable to our mass market wired, mobile and Wi-Fi broadband internet access services, consistent with the Federal Communications Commission's Open Internet Rules. This information should help customers make informed choices about how to use those services, and will assist providers of internet applications, content and services in developing, marketing and maintaining their internet offerings. We encourage mass market customers and other users of our network to familiarize themselves with this information, and to provide AT&T with feedback about our mass market broadband internet access services so that we can continue to provide an excellent experience.

42.   The "AT&T network is a shared network, which means that the transmission links and other network resources used to provide broadband services are shared among AT&T's subscribers, as well as among the various services offered by AT&T."[16] Accordingly, congestion may occur "when a large number of customers in a concentrated area access the network at the same time or when some customers consume a very large amount of network capacity during busy periods, such as at stadium events, during peak usage times, or during planned network maintenance."[17]

> In addition, like the other networks that make up the internet, the AT&T network is a shared network, which means that the transmission links and other network resources used to provide broadband services are shared among AT&T's subscribers, as well as among the various services offered by AT&T. Temporary congestion may occur when a large number of customers in a concentrated area access the network at the same time or when some customers consume a very large amount of network capacity during busy periods, such as at stadium events, during peak usage times, or during planned network maintenance.

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[15] https://about.att.com/sites/broadband (last visited Oct. 14, 2021).
[16] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[17] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

43.   AT&T uses "network management practices and other tools to manage network resources for the benefit of all of [AT&T] broadband customers, especially during periods when network demand exceeds available network resources (also known as 'congestion')."[18]

> AT&T invests billions of dollars annually to address potential congestion in its broadband networks. As is common in the industry, we use network management practices and other tools to manage network resources for the benefit of all of our broadband customers, especially during periods when network demand exceeds available network resources (also known as "congestion"). As you would expect, our network management practices and our service offerings have evolved over time to benefit our customers and take advantage of the billions we have spent to expand and augment our networks.

44.   AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[19] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[20] Once "the congestion at the cell site abates, or if the customer's session migrates to an uncongested cell site, speeds and latency are not affected."[21] This network management practice utilized by AT&T "adjusts dynamically to address the amount of congestion, which can start and stop over a very short time period."[22] Accordingly, "[b]ecause the amount of congestion at a cell site can vary significantly, the performance impact for affected AT&T Unlimited Data Plan customers may also vary significantly."[23]

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[18] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[19] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[20] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[21] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[22] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[23] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

> Congestion-based Data Management. One network management practice we use to manage our wireless network resources may affect customers with most AT&T post-paid and AT&T PREPAID[SM] unlimited mobile data plans ("AT&T Unlimited Data Plans"). During periods of congestion, these customers may experience reduced data speeds and increased latency as compared to other customers using the same cell site ("Congestion-based Data Management"). Depending on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period). As always, even when subject to this congestion management practice, these customers have the comfort of knowing that, no matter how much data they use in a billing cycle, they will never be subject to overage charges and will pay a single monthly flat rate. That is our essential promise with the AT&T Unlimited Data Plans. Reduced speeds and increased latency may cause web sites to load more slowly or affect the performance of data-heavy activities such as video streaming or interactive gaming. Customers subject to Congestion-based Data Management will experience reduced speeds and increased latency only when they use data at a cell site experiencing network congestion at the same moment. As soon as the congestion at the cell site abates, or if the customer's session migrates to an uncongested cell site, speeds and latency are not affected. In addition, this network management practice adjusts dynamically to address the amount of congestion, which can start and stop over a very short time period (often measured in fractions of a second), further minimizing any customer impact. Because the amount of congestion at a cell site can vary significantly, the performance impact for affected AT&T Unlimited Data Plan customers may also vary significantly, but such impact will last only as long as the site is congested.

45.   On the AT&T network, a user's service may be interrupted, delayed, or otherwise limited … during periods of congestion, to accommodate the needs of national security and emergency preparedness personnel."[24]

> AT&T offers a wide variety of services to its customers over AT&T's network infrastructure including Voice over Internet Protocol (VoIP), Internet Protocol (IP)-video, unified messaging, Voice over LTE (VoLTE), enterprise networking, public safety (including FirstNet), and national security services. These services share AT&T's network infrastructure and may rely on network practices to assign different levels of priority dynamically or statically. Use of these services may affect the availability of network resources for broadband internet access services, and thus the performance of that service. For example, your service may be interrupted, delayed, or otherwise limited in the event of a disaster or emergency, or during periods of congestion, to accommodate the needs of national security and emergency preparedness personnel. In addition, although AT&T engineers its network to accommodate all users and user types based on a variety of factors, including average and anticipated peak usage of the network, many factors cannot be anticipated or are outside of AT&T's control. These factors can impact the availability of network resources for mass market broadband internet access services at any particular time. Consequently, AT&T does not guarantee the performance of your service on an end-to-end basis.

46.   The mobile services provided by AT&T may be affected by a number of factors including "the capacity of the cell cite" being utilized by a user, "the number of other users connected to the same cell site and the services they are using," and the "applicable network management practices."[25]

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[24] https://about.att.com/sites/broadband/performance (last visited Oct. 14, 2021).
[25] https://about.att.com/sites/broadband/performance (last visited Oct. 14, 2021).

- *Mobile Services*. Service performance may be affected by your proximity to a cell site, the capacity of the cell site, the technology at the cell site, the number of other users connected to the same cell site and the services they are using, the surrounding terrain, use inside a building or a moving vehicle, radio frequency interference, your mobile data plan, the capabilities of your device, applicable network management practices as discussed on this page, and the applications you use. In addition, AT&T has designed its wireless services to provide our customers with a high-quality voice experience during simultaneous voice and data sessions, which may affect data performance, including but not limited to a temporary reduction in speed to minimize the likelihood of dropped calls.

47.   According to the AT&T Consumer Service Agreement, AT&T reserves the right

to modify any AT&T service (including the services using the AT&T Network) for "any failure to

make all required payments when due."[26]

AT&T reserves the right to modify, suspend, or discontinue any function or feature of any AT&T Service, including your rates or charges, or to terminate your AT&T Service entirely, for any reason, which may include, but is not limited to:

- any misconduct by you or any user of your AT&T Services (as defined below);
- compliance with an order by a state or federal agency, court, or arbitrator; and
- any interruption or loss of either your or AT&T's rights to access any part of the network facilities required to provide your services, including the interruption or loss of any rights to access the land or buildings in which the facilities are located;

Misconduct includes but is not limited to the following conduct by you or any user or your AT&T Services:

- any conduct that we believe violates this Agreement or AT&T's Acceptable Use Policy;
- any conduct that involves the use of abusive, threatening, or unreasonable conduct toward any of our employees or representatives, whether in person, over the phone, or in writing;
- any abusive, fraudulent, or unlawful use of any AT&T Services;
- providing us with false or misleading information about you, users of your AT&T Services, or your or their use of AT&T Services, including inaccurate information related to your creditworthiness;
- any use of AT&T Services in a manner that negatively affects our or others' networks, customers, or operations, or that infringes anyone's intellectual property rights, violates others' privacy, generates spam or abusive messaging or calling, or results in the publication of threatening, offensive, or illegal materials;
- any reselling of AT&T Services (including selling of use of or access to AT&T Services); and
- any failure to make all required payments when due or to maintain sufficient amounts on deposit or pay another form of credit security, as well as any change that we determine creates a risk of non-payment (such as a deterioration in your creditworthiness.

48.   AT&T offers a number of "unlimited" data plans for a number of user products

including, for example, smart phones, tablets, smart watches, and connected cars.[27] These include,

for example, the "AT&T Unlimited Elite" plan, the "AT&T Unlimited Extra" plan, and the

"AT&T Unlimited Starter" plan.[28]

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[26] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[27] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[28] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

49.   For customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[29]

50.   For customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[30]

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[29] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[30] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

51.   All AT&T Service plans are "subject to AT&T network management policies."[31] Moreover, "[a]ll AT&T wireless services [are] subject to terms and conditions in the Consumer Service Agreement."[32]

All AT&T service is subject to AT&T network management policies. See att.com/broadbandinfo for details.

AT&T UNLIMITED ELITE® PLAN: All AT&T wireless services subject to terms and conditions in the Consumer Service Agreement (att.com/csa).

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[31] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[32] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

52.   The AT&T Consumer Service Agreement further states that with respect to the AT&T "Unlimited Data Service" a customer agrees "that 'unlimited' does not mean that wireless data will be transmitted at any particular speed."[33] AT&T states that "[r]educed data throughput speeds mean [a user] may experience reduced data speeds and increased latency, which may cause websites to load more slowly and affect the performance of data-heavy activities such as video streaming."[34] Such "reduced data speeds" apply "when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site."[35] On the AT&T Network, "[s]tandard speeds will resume once the cell site is no longer congested or when your data session moves to an uncongested cell site, and speeds will no longer be reduced during periods of network congestion at the start of your next billing period, unless your usage again exceeds an applicable, identified data usage threshold for that next billing period."[36]

2.6 Unlimited Data Service

If you are subscribed to an AT&T unlimited data plan, you agree that "unlimited" means you pay a single monthly flat rate for wireless Data Service regardless of how much data you use. You further agree that "unlimited" does not mean that wireless data will be transmitted at any particular speed or that you can use AT&T's wireless Data Service in any way that you choose or for any Prohibited Network Uses. If you use your unlimited data plan in any manner that is prohibited, AT&T can limit, restrict, suspend or terminate your Data Service. We may also migrate you from the unlimited data plan to a tiered data plan and charge you the appropriate monthly fees. We will provide you with notice of this change at least one billing period in advance either by a bill message, email, text message, or other appropriate means.

Except for FirstNet individual users, AT&T may also reduce your data throughput speeds at any time based on the terms of your data plan, which may include times when your usage exceeds an applicable, identified data usage threshold during any billing period. Reduced data throughput speeds mean you may experience reduced data speeds and increased latency, which may cause websites to load more slowly and affect the performance of data-heavy activities such as video streaming.

Reduced data throughput speeds apply when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site. Standard speeds will resume once the cell site is no longer congested or when your data session moves to an uncongested cell site, and speeds will no longer be reduced during periods of network congestion at the start of your next billing period, unless your usage again exceeds an applicable, identified data usage threshold for that next billing period.

There are no mobile network-related speed reductions if you use Wi-Fi, and Wi-Fi data usage does not count against a monthly data usage threshold for wireless Data service. For more information, go to att.com/broadbandinfo and att.com/datainfo.

53.   AT&T's wireless home Internet service uses "mobile wireless gateway equipment … to provide Internet access via the AT&T wireless network."[37]

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[33] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[34] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[35] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[36] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[37] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).

6.14.3 AT&T Wireless Home Internet Service: AT&T Wireless Home Internet service uses mobile wireless gateway equipment called an AT&T Wireless Home Internet device ("WI Device") to provide Internet access via the AT&T wireless networks. With AT&T Wireless Home Internet service, the WI Device allows you to connect internet-capable devices via an included Ethernet port and via a Home Wi-Fi network generated from the WI Device. All devices connected to the WI Device will share the same connection to the wireless network.

54.   Similarly, with respect to AT&T wireless home internet services, the AT&T

Consumer Service Agreement requires that customers acknowledge that "AT&T may engage in

any reasonable network management practice to enhance customer service, to reduce network

congestion, to adapt to advances and changes in technology, and/or to respond to the availability

of wireless bandwidth and spectrum…."[38]

6.14.1.3 AT&T's Network Management: With respect to your Wireless Home Internet Services, you agree that AT&T has the right to do the following:

- AT&T may modify, without advance notice, the permitted and prohibited activities by this Agreement;
- AT&T may engage in any reasonable network management practice to enhance customer service, to reduce network congestion, to adapt to advances and changes in technology, and/or to respond to the availability of wireless bandwidth and spectrum, including by taking any actions authorized by subsection 7.9.2;
- AT&T will provide you with advance notice of the usage threshold applicable to your data plan, or any changes to the applicable usage threshold either by a bill insert, email, text message or other appropriate means; and
- AT&T may use reasonable methods to monitor and collect customer usage information to better optimize the operation of the network. Details concerning the information that AT&T collects about its customers, and how it uses and protects that information are addressed in the AT&T Privacy Policy (see att.com/privacy).

55.   The AT&T LTE network is composed of two major elements: (1) a "radio access

network that is optimized for an all IP-based traffic network;" and (2) an "evolutionary core

network architecture called Service Architecture Evolution (SAE) which is also known as Evolved

Packet Core (EPC)."[39]

LTE is composed of two major elements:

- A new radio access network that is optimized for an all IP-based traffic network.
- An evolutionary core network architecture called Service Architecture Evolution (SAE) which is also known as Evolved Packet Core (EPC).

56.   On information and belief, the following block diagram depicts the architecture of

the AT&T 4G LTE network:[40]

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[38] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[39] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[40] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
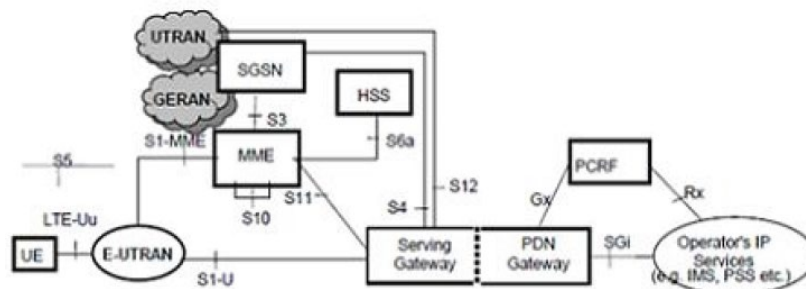
57.   The AT&T 4G LTE network includes a number of base stations or "eNode Bs" which provide "control and user data transport and protocols for the User Equipment (UE)."[41] The eNode Bs are connected to the EPC.[42] The UEs may be any device with wireless communication functionality (e.g., cellular or mobile wireless network) such as, for example, handheld wireless communication devices like mobile phones, smartphones, or tablets.

LTE Architecture

LTE has a flat all IP architecture and has fewer nodes than the UMTS network. The Evolved Universal Terrestrial Radio Access Network (E-UTRAN) consists of eNode Bs (eNB), providing control and user data transport and protocols for the User Equipment (UE). The eNode Bs are interconnected with each other by means of the X2 interface. The eNode Bs are also connected by means of the S1 interface to the EPC (Evolved Packet Core).

58.   The AT&T 4G LTE network "supports policy and charging control mechanisms" which is a functionality that "enables traffic prioritization within the LTE Gateways."[43] The Policy and Charging Control (PCC) architecture of the AT&T 4G LTE network "has two major functional elements, the Policy and Charging Rules Function (PCRF) and the Policy and Charging Enforcement Function (PCEF)."[44] "The PCRF maintains the rules for network operations and filters the resource requests against policy rules and makes decisions about network

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[41] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[42] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[43] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[44] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).

performance."[45] "These rules and decisions are based on subscriber profiles."[46] "PCEF enforces the policy decisions by prioritizing service data flow."[47]

LTE supports policy and charging control mechanisms initially introduced in Release 7. This functionality enables traffic prioritization within the LTE Gateways. The Policy and Charging Control (PCC) architecture has two major functional elements, the Policy and Charging Rules Function (PCRF) and the Policy and Charging Enforcement Function (PCEF). The PCRF maintains the rules for network operations and filters the resource requests against policy rules and makes decisions about network performance. These rules and decisions are based on subscriber profiles. PCEF enforces the policy decisions by prioritizing service data flow.
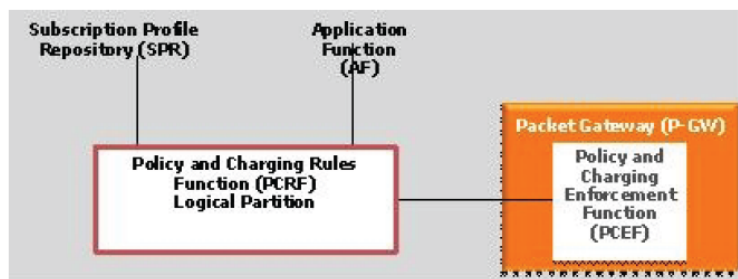
59.   The AT&T 5G network complies with 3GPP 5G standards including, for example, 3GPP TS 23.501 (hereinafter, "TS 23.501") titled "5G; System Architecture for the 5G System."[48]

60.   On information and belief, in AT&T's 5G network, the access network includes a number of components including, for example, one or more base stations, User Plane Function (UPF), Application Function (AF), Unified Data Management (UDM) and a Policy Control Function (PCF).

61.   The UPF may perform packet routing and forwarding, perform the user plane part of policy rule enforcement, perform packet inspection, perform traffic usage reporting, enforce QoS policies in the user plane, perform transport level packet marking, and/or perform other types of user plane processes.

[45] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[46] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[47] https://developer.att.com/technical-library/network-technologies/long-term-evolution (last visited Oct. 14, 2021).
[48] *See, e.g.,* https://www.etsi.org/deliver/etsi_ts/123500_123599/123501/15.02.00_60/ts_123501v150200p.pdf (last visited Oct. 15, 2021).

62.   The AF may provide services associated with a particular application, such as, for example, application influence on traffic routing, interacting with a policy framework for policy control, and/or other types of applications.

63.   The UDM may maintain subscription information for UEs, manage subscriptions, generate authentication credentials, handle user identification, perform access authorization based on subscription data, perform network function registration management, maintain service and/or session continuity, support SMS delivery, support lawful intercept functionality, and/or perform other processes associated with managing user data. On information and belief, the UDM in the AT&T 5G network is analogous in functionality to the HSS in the AT&T 4G LTE network.[49]

64.   The PCF may support policies to control network behavior, provide policy rules to control plane functions, access subscription information relevant to policy decisions, execute policy decisions, and/or perform other types of processes associated with policy enforcement. PCF may specify QoS policies based on QoS flow identity (QFI) consistent with 5G network standards. On information and belief, the PCF in AT&T's 5G network performs the same functions as the PCRF in AT&T's 4G LTE network.[50]

65.   3GPP TS 23.203 (hereinafter, "TS 23.203") titled "Technical Specification Group Services and System Aspects; Policy and charging control architecture" is a standard adopted by the 3rd Generation Partnership Project.[51]

66.   The scope of TS 23.203 is defined as follows:[52]

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[49] *See, e.g.,* https://5g.systemsapproach.org/arch.html (last visited Oct. 15, 2021).
[50] *See, e.g.,* https://5g.systemsapproach.org/arch.html (last visited Oct. 15, 2021).
[51] *See, e.g.,* 3GPP TS 23.203 V 15.5.0 (2019-06) (Release 15) (hereinafter, "TS 23.203"), available at https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=810
[52] TS 23.203 at 14.

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1   Scope

The present document specifies the overall stage 2 level functionality for Policy and Charging Control that encompasses the following high level functions for IP-CANs (e.g. GPRS, Fixed Broadband, EPC, etc.):

- Flow Based Charging for network usage, including charging control and online credit control, for service data flows and application traffic;

- Policy control (e.g. gating control, QoS control, QoS signalling, etc.).

The present document specifies the Policy and Charging Control functionality for Evolved 3GPP Packet Switched domain, including both 3GPP accesses GERAN/UTRAN/E-UTRAN and Non-3GPP accesses, according to TS 23.401 [17] and TS 23.402 [18].

The present document specifies functionality for unicast bearers. Broadcast and multicast bearers, such as MBMS contexts for GPRS, are out of scope of the present document.

NOTE: For E-UTRAN access, the usage of functionalities covered in this specification for features such as MBMS, CIoT and V2X is described in TS 23.246 [6], TS 23.682 [42] and TS 23.285 [48], respectively.

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67.   On information and belief, the AT&T network complies with TS 23.203 standard.

68.   For instance, AT&T supports the Nationwide Public Safety Broadband Network (NPSBN).[53] On information and belief, at least with respect to NPSBN, the Federal Communications Commission requires compliance with TS 23.203.[54]

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[31] The NPSBN SHALL support all 9 QCI classes specified in table 6.1.7 of 3GPP
23.203 v9.11 or future
equivalents.
[32] QoS mechanisms in the NPSBN SHALL comply with 3GPP TS 23.203.
[33] The NPSBN SHALL support the usage of all 15 ARP values defined in 3GPP 23.203.

[34] The NPSBN SHALL support the ARP pre-emption capability and vulnerability
functions as defined in
3GPP 23.203.
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[53] https://www.firstnet.com/ (last visited Oct. 14, 2021).
[54] *See, e.g.,* Recommended Minimum Technical Requirements to Ensure Nationwide Interoperability for the Nationwide Public Safety Broadband Network, prepared by Technical Advisory Board for First Responder Interoperability Final Report (May 22, 2012) available at https://docs.fcc.gov/public/attachments/FCC-12-68A3.txt (last visited Aug. 19, 2021).

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These mechanisms are used by the LTE network, for example, to determine how packets
should be scheduled for
transmission and how other network resources should be assigned to users to ensure
the delay, loss and throughput
requirements of the IP flows are met.
3GPP TS 23.203 defines a standardized set of QoS Class Identifiers (QCIs) (shown in
the table below).  This set of
QCIs describes the QoS characteristics of all applications that are currently
envisioned to be carried over an LTE
network.  Use of a common set of QCI definitions across the NPSBN facilitates
interoperability by ensuring there is
a common way to describe the QoS requirements of all applications which use the
NPSBN.  Use of the standardized
set of QCIs defined in the table below also facilitates roaming onto commercial
networks – as these networks also
use the same standard definitions of QCI defined in TS 23.203.
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69.   The National Public Safety Telecommunications Council ("NPSTC") is "a federation of organizations whose mission is to improve public safety communications and interoperability through collaborative leadership."[55] On information and belief, AT&T complies with the requirements of the NPSTC. A Technical Working Group at NPSTC issued a document setting forth "the minimum requirements necessary to enable roaming between LTE networks built by multiple, independent public safety organizations and commercial service providers."[56] In that document, NPSTC states that "Quality of Service (QoS), priority and pre-emptive access are all important features to public safety networks" and that Public Safety Networks "should utilize QoS as defined in [TS 23.401 and in TS 23.203]."[57]

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[55] https://www.npstc.org/index.jsp (last visited Oct. 18, 2021).
[56] https://www.npstc.org/documents/LTE_System_Interoperability.pdf (last visited Oct. 18, 2021).
[57] https://www.npstc.org/documents/LTE_System_Interoperability.pdf (last visited Oct. 18, 2021).

NPSTC 700 MHz Broadband Network Requirements Task Force (Task Force)

Technical Working Group

700 MHz LTE Network Interoperability

Scope

To document the minimum requirements necessary to enable roaming between LTE networks built by multiple, independent public safety organizations and commercial service providers, where roaming users will have initial access to the Internet, <additional applications/services as defined by operations WG>.

This does not prevent organizations from deploying additional applications/services that are available to roaming users, but provides a minimum expectation.

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Quality of Service (QoS), priority and pre-emptive access are all important features to public safety networks. Within 3GPP Release 8, QoS is defined in TS 23.401 and in TS 23.203. Public Safety Networks should utilize QoS as defined in these documents.

70.   3GPP TS 23.401 (hereinafter, "TS 23.401") titled "LTE; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access" is a standard adopted by the 3rd Generation Partnership Project.[58]

71.   On information and belief, the AT&T Network complies with TS 23.401 standard.[59]

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[58] *See, e.g.,* 3GPP TS 23.401 V 16.1.0 (2021-04) (Release 15) (hereinafter, "TS 23.401"), available at https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=849 (last visited Aug. 19, 2021).

[59] *See, e.g.,* https://www.att.com/Common/about_us/files/pdf/One%20Voice_v1_0_0_2009-11-3.pdf (last visited Oct. 14, 2021).

INFRINGEMENT OF U.S. PATENT NO. RE47,813

72.   On January 14, 2020, the United States Patent and Trademark Office ("USPTO") duly and legally issued United States Patent No. RE47,813 ("the '813 Patent"), entitled "Feedback Loop for Dynamic Network Resource Allocation."

73.   The inventions disclosed in the '813 Patent provide "[a] system, apparatus and method for dynamic resource allocation" within a computer network. '813 Patent, Abstract. These inventions provide technological solutions to the network-centric problem of managing the allocation of network resources (*e.g.*, bandwidth) for use by a plurality of user devices, each having a corresponding service profile and billing profile. *See id.* Network congestion is unpredictable and it can compromise the quality of service provided to (or guaranteed to) user terminals or devices (*e.g.*, cellular phones). *See id.* at 1:28-31. The improvements of the claimed inventions allow network operators to manage network congestion by prioritizing one or more user terminals or devices (e.g., cellular phones) sharing the network. The '813 Patent claims patent-eligible subject matter and is valid and enforceable.

74.   TNS holds all rights, title, and interest in and to the '813 Patent, including the right to bring this suit and recover all past, present and future damages for infringement of the '813 Patent. AT&T is not licensed to the '813 Patent, either expressly or implicitly, nor does it enjoy or benefit from any other rights in or to the '813 Patent whatsoever. As such, AT&T's infringement described below has injured, and continues to injure, TNS.

75.   On information and belief, AT&T has infringed directly and continues to infringe directly the '813 Patent. The infringing acts include, but are not limited to, the manufacture, use, sale, importation, and/or offer for sale of products and/or services from AT&T which prioritize data transfer rates with respect to one or more users (or devices) on the AT&T network as part of

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the network management functionality in the AT&T Network (collectively, "Accused Instrumentalities").

76.   For example, the Accused Instrumentalities practice and/or are capable of practicing representative claim 1 of '813 Patent. The following paragraphs provide details regarding only one example of AT&T's infringement, and only as to a single patent claim. Plaintiff reserves its right to provide greater detail and scope via its Infringement Contentions at the time required under this Court's scheduling order.

77.   Claim 1 of the '813 Patent recites:

1. A method for dynamic allocation of network resources comprising:
receiving a service profile for each of a plurality of devices sharing a network resource;
receiving a billing profile for each of said plurality of devices;
generating a prioritization list defining an order of said plurality of devices, based on said billing profiles and on a billing history for each of said plurality of devices;
repeating:
receiving traffic profiles over said network resource for said plurality of devices;
managing said network resource according to said service profile and said billing profile if said network resource is fully utilized by said traffic profiles; and,
selecting at least one of said devices based on said prioritization list and
dynamically modifying at least one of said service profile and said billing profile for said selected devices, if said network resource is under-utilized by said traffic profile or if said network resource would be over-utilized by said traffic profiles;
until said plurality of devices no longer continue to share said network resource; and
when said plurality of devices are no longer sharing said network resource, clearing said prioritization list.

'813 Patent at 14:30-55.

78.   The network management functionality of the Accused Instrumentalities implements the recited method for dynamic allocation of network resources. The Accused Instrumentalities dynamically allocate network resources (e.g., cell sites). AT&T uses "network management practices and other tools to manage network resources for the benefit of all of [its]

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broadband customers, especially during periods when network demand exceeds available network resources (also known as 'congestion').["60] AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[61] Once "the congestion at the cell site abates, or if the customer's session migrates to an uncongested cell site, speeds and latency are not affected."[62] This network management practice utilized by AT&T "adjusts dynamically to address the amount of congestion, which can start and stop over a very short time period."[63]

79.   AT&T dynamically allocates network resources by prioritizing one Unlimited data plan over another if the network is congested. For example, with respect to customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[64] Similarly, with respect to customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[65]

80.   On the AT&T network "reduced data speeds" apply "when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site."[66] On the AT&T Network, "[s]tandard speeds will resume once the cell site is no longer congested or when [the] data session moves to an uncongested cell site, and speeds will no longer be reduced during periods of network congestion at the start of your next billing period, unless

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[60] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[61] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[62] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[63] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[64] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[65] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[66] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).

your usage again exceeds an applicable, identified data usage threshold for that next billing period."[67]

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IP-CAN session: The association between a UE and an IP network. The association is identified by one IPv4 and/or an IPv6 prefix together with UE identity information, if available, and a PDN represented by a PDN ID (e.g. an APN). An IP-CAN session incorporates one or more IP-CAN bearers. Support for multiple IP-CAN bearers per IP-CAN session is IP-CAN specific. An IP-CAN session exists as long as UE IP addresses/prefix are established and announced to the IP network.

4.4   Usage Monitoring Control

It shall be possible to apply usage monitoring for the accumulated usage of network resources on a per IP-CAN session and user basis. This capability is required for enforcing dynamic policy decisions based on the total network usage in real-time.

The PCRF that uses usage monitoring for making dynamic policy decisions shall set and send the applicable thresholds to the PCEF or TDF for monitoring. The usage monitoring thresholds shall be based either on time, or on volume. The PCRF may send both thresholds to the PCEF or TDF. The PCEF or TDF shall notify the PCRF when a threshold is reached and report the accumulated usage since the last report for usage monitoring. If both time and volume thresholds were provided to the PCEF or TDF, the accumulated usage since last report shall be reported when either the time or the volume thresholds are reached.

NOTE: There are reasons other than reaching a threshold that may cause the PCEF/TDF to report accumulated usage to the PCRF as defined in clauses 6.2.2.3 and 6.6.2.

5.1   Reference architecture

The PCC functionality is comprised by the functions of the Policy and Charging Enforcement Function (PCEF), the Bearer Binding and Event Reporting Function (BBERF), the Policy and Charging Rules Function (PCRF), the Application Function (AF), the Traffic Detection Function (TDF), the Traffic Steering Support Function (TSSF), the Online Charging System (OCS), the Offline Charging System (OFCS) and the Subscription Profile Repository (SPR) or the User Data Repository (UDR). UDR replaces SPR when the UDC architecture as defined in TS 23.335 [25] is applied to store PCC related subscription data. In this deployment scenario Ud interface between PCRF and UDR is used to access subscription data in the UDR.

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[67] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[68] *See, e.g.,* TS 23.203 at pp. 17, 25, 28, 31, and 69.

Figure 5.1-1: Overall PCC logical architecture (non-roaming) when SPR is used

5.2.2   Gx reference point

The Gx reference point resides between the PCEF and the PCRF.

The Gx reference point enables the PCRF to have dynamic control over the PCC behaviour at a PCEF.

The Gx reference point enables the signalling of PCC decision, which governs the PCC behaviour, and it supports the following functions:

-    Establishment of Gx session (corresponding to an IP-CAN session) by the PCEF;

-    Request for PCC decision from the PCEF to the PCRF;

-    Provision of IP flow mobility routing information from PCEF to PCRF; this applies only when IP flow mobility as defined in TS 23.261 [23] is supported;

-    Provision of PCC decision from the PCRF to the PCEF;

-    Reporting of the start and the stop of detected applications and transfer of service data flow descriptions and application instance identifiers for detected applications from the PCEF to the PCRF;

-    Reporting of the accumulated usage of network resources on a per IP-CAN session basis from the PCEF to the PCRF;

-    Delivery of IP-CAN session specific parameters from the PCEF to the PCRF or, if Gxx is deployed, from the PCRF to the PCEF per corresponding request;

-    Negotiation of IP-CAN bearer establishment mode (UE-only or UE/NW);

-    Termination of Gx session (corresponding to an IP-CAN session) by the PCEF or the PCRF.

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6.2.1   Policy Control and Charging Rules Function (PCRF)

6.2.1.0   General

The PCRF encompasses policy control decision and flow based charging control functionalities.

The PCRF provides network control regarding the service data flow detection, gating, QoS and flow based charging (except credit management) towards the PCEF and/or TDF.

The PCRF provides network control regarding the application detection, gating, QoS and application based charging (except credit management) towards the TDF and the PCEF enhanced with ADC.

The PCRF shall apply the security procedures, as required by the operator, before accepting service information from the AF.

The PCRF shall decide whether application traffic detection is applicable, as per operator policies, based on user profile configuration, received within subscription information.

The PCRF shall decide how certain service/application traffic shall be treated in the PCEF and in the TDF, if applicable, and ensure that the PCEF user plane traffic mapping and treatment is in accordance with the user's subscription profile.

82.   The Accused Instrumentalities receive a service profile for each of a plurality of devices sharing a network resource. For instance, the AT&T plans include an overall bit-rate cap or data volume cap. On the AT&T network, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[69] For instance, for customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[70] Similarly, for customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[71]

83.   For instance, this functionality is implemented in the access network of the AT&T Network, in part in conjunction with the PCF/PCRF.[72]

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[69] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[70] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[71] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[72] *See, e.g.,* TS 23.203 at pp. 24, 32, 69-70, 76, 91-93.

4.3.3   QoS control

4.3.3.1   QoS control at service data flow level

It shall be possible to apply QoS control on a per service data flow basis in the PCEF.

QoS control per service data flow allows the PCC architecture to provide the PCEF with the authorized QoS to be enforced for each specific service data flow. Criteria such as the QoS ==subscription information may be used together with policy rules such as, service-based, subscription-based, or predefined PCRF internal policies to derive the authorized QoS to be enforced for a service data flow==.

It shall be possible to apply multiple PCC rules, without application provided information, using different authorised QoS within a single IP-CAN session and within the limits of the Subscribed QoS profile.

4.3.3.2   QoS control at IP-CAN bearer level

It shall be possible for the PCC architecture to support control of QoS reservation procedures (UE-initiated or network-initiated) for IP-CANs that support such procedures for its IP-CAN bearers in the PCEF or the BBERF, if applicable. It shall be possible to determine the QoS to be applied in QoS reservation procedures (QoS control) ==based on the authorised QoS of the service data flows that are applicable to the IP-CAN bearer and on criteria such as the QoS subscription information, service based policies, and/or predefined PCRF internal policies==. Details of QoS reservation procedures are IP-CAN specific and therefore, the control of these procedures is described in Annex A and Annex D.

It shall be possible for the PCC architecture to support control of QoS for the packet traffic of IP-CANs.

The PCC architecture shall be able to provide policy control in the presence of NAT devices. This may be accomplished by providing appropriate address and port information to the PCRF.

The enforcement of the control for QoS reservation procedures for an IP-CAN bearer shall allow for a downgrading or an upgrading of the requested QoS as part of a UE-initiated IP-CAN bearer establishment and modification. The PCC architecture shall be able to provide a mechanism to initiate IP-CAN bearer establishment and modification (for IP-CANs that support such procedures for its bearers) as part of the QoS control.

The IP-CAN shall prevent cyclic QoS upgrade attempts due to failed QoS upgrades.

  NOTE: These measures are IP-CAN specific.

The PCC architecture shall be able to handle IP-CAN bearers that require a guaranteed bitrate (GBR bearers) and IP-CAN bearers for which there is no guaranteed bitrate (non-GBR bearers).

5.2.3   Reference points to subscriber databases

5.2.3.1   Sp reference point

The Sp reference point lies between the SPR and the PCRF.

==The Sp reference point allows the PCRF to request subscription information related to the IP-CAN transport level policies from the SPR based on a subscriber ID, a PDN identifier and possible further IP-CAN session attributes==, see Annex A and Annex D. For example, the subscriber ID can be IMSI. The reference point allows the SPR to notify the PCRF when the subscription information has been changed if the PCRF has requested such notifications. The SPR shall stop sending the updated subscription information when a cancellation notification request has been received from the PCRF.

  NOTE: The details associated with the Sp reference point are not specified in this Release.

5.2.3.2   Ud reference point

The Ud reference point resides between the UDR and the PCRF, acting as an Application Frontend as defined in TS 23.335 [25]. ==It is used by the PCRF to access PCC related subscription data when stored in the UDR.==

The details for this reference point are described in TS 23.335 [25] and TS 29.335 [26].

6.2.1.2   Subscription information management in the PCRF

The ==PCRF may request subscription information== from the SPR for an IP-CAN session at establishment or a gateway control session at establishment. The subscription information may include user profile configuration indicating whether application detection and control should be enabled. The PCRF should specify the subscriber ID and, if available, the PDN identifier in the request. The PCRF should retain the subscription information that is relevant for PCC decisions until the IP-CAN session termination and the gateway control session termination.

The PCRF may request notifications from the SPR on changes in the subscription information. Upon reception of a notification, the PCRF shall make the PCC decisions necessary to accommodate the change in the subscription and updates the PCEF and/or the BBERF and/or the TDF by providing the new PCC and/or QoS and/or ADC decisions if needed. The PCRF shall send a cancellation notification request to the SPR when the related subscription information has been deleted.

The PCRF provides network control regarding the service data flow detection, gating, QoS and flow based charging (except credit management) towards the PCEF and/or TDF.

The PCRF provides network control regarding the application detection, gating, QoS and application based charging (except credit management) towards the TDF and the PCEF enhanced with ADC.

The PCRF shall apply the security procedures, as required by the operator, before accepting service information from the AF.

The PCRF shall decide whether application traffic detection is applicable, as per operator policies, based on user profile configuration, received within subscription information.

The PCRF shall decide how certain service/application traffic shall be treated in the PCEF and in the TDF, if applicable, and ensure that the PCEF user plane traffic mapping and treatment is in accordance with the user's subscription profile.

If Gxx applies, the PCRF shall provide QoS rules with identical service data flow templates as provided to the PCEF in the PCC rules. If the service data flow is tunnelled at the BBERF, the PCRF shall provide the BBERF with information received from the PCEF to enable the service data flow detection in the mobility tunnel at the BBERF. In case 2a, defined in clause 7.1, the PCRF may also provide to the BBERF the charging ID information received from the PCEF. If IP flow mobility as specified in TS 23.261 [23] applies, the PCRF shall, based on IP flow mobility routing rules received from the PCEF, provide the authorized QoS rules to the applicable BBERF as specified in clause 6.1.1.3.

The PCRF should for an IP-CAN session derive, from IP-CAN specific restrictions, operator policy and SPR data, the list of permitted QoS class identifiers and associated GBR and MBR limits for the IP-CAN session.

The PCRF may check that the service information provided by the AF is consistent with both the operator defined policy rules and the related subscription information as received from the SPR during IP-CAN session establishment before storing the service information. The service information shall be used to derive the QoS for the service. The PCRF may reject the request received from the AF when the service information is not consistent with either the related subscription information or the operator defined policy rules and as a result the PCRF shall indicate that this service information is not covered by the subscription information or by operator defined policy rules and may indicate, in the response to the AF, the service information that can be accepted by the PCRF (e.g. the acceptable bandwidth). In the absence of other policy control mechanisms outside the scope of PCC, it is recommended that the PCRF include this information in the response.

When receiving service information from the AF, the PCRF may temporarily reject the AF request (e.g. if the service information is not consistent with the operator defined policy rules for the congestion status of the user). To temporarily reject the AF request the PCRF shall indicate a re-try interval to the AF. When receiving a re-try interval from the PCRF the AF shall not send the same service information to the PCRF again (for the same IP-CAN session) until the re-try interval has elapsed.

> NOTE 1: How the PCRF derives the re-try interval is up to implementation.

In this Release, the PCRF supports only a single Rx reference point, i.e. there is one AF for each AF session.

The PCRF authorizes QoS resources. The PCRF uses the service information received from the AF (e.g. SDP information or other available application information) and/or the subscription information received from the SPR to calculate the proper QoS authorization (QoS class identifier, bitrates). The PCRF may also take into account the requested QoS received from the PCEF via Gx interface.

> NOTE 2: The PCRF provides always the maximum values for the authorized QoS even if the requested QoS is lower than what can be authorized.

The Authorization of QoS resources shall be based on complete service information unless the PCRF is required to perform the authorization of QoS resources based on incomplete service information. The PCRF shall after receiving the complete service information, update the affected PCC rules accordingly.

The PCRF may use the subscription information as basis for the policy and charging control decisions. The subscription information may apply for both session based and non-session based services.

6.2.4   Subscription Profile Repository (SPR)

The SPR logical entity contains all subscriber/subscription related information needed for subscription-based policies and IP-CAN bearer level PCC rules by the PCRF. The SPR may be combined with or distributed across other databases in the operator's network, but those functional elements and their requirements for the SPR are out of scope of this document.

NOTE 1:   The SPR's relation to existing subscriber databases is not specified in this Release.

The SPR may provide the following subscription profile information (per PDN, which is identified by the PDN identifier):

- Subscriber's allowed services;

- For each allowed service, a pre-emption priority;

- Information on subscriber's allowed QoS, including the Subscribed Guaranteed Bandwidth QoS;

- Subscriber's charging related information (e.g. location information relevant for charging);

- Subscriber's User CSG Information reporting rules.

- List of Presence Reporting Area identifiers and optionally the elements for one or more of the Presence Reporting Areas;

- Subscriber category;

- Subscriber's usage monitoring related information;

- MPS EPS Priority and MPS Priority Level;

- IMS Signalling Priority;

- Subscriber's profile configuration indicating whether application detection and control can be enabled.

- Spending limits profile containing an indication that policy decisions are based on policy counters available at OCS that has a spending limit associated with it and optionally the list of policy counters.

The SPR may provide the following sponsored data connectivity profile information:

- A list of Application Service Providers and their applications per sponsor identity.

NOTE 2:   The sponsored data connectivity profile may be locally configured at the PCRF.

If the IMS Signalling Priority is set, it indicates that the IMS Signalling Bearer and the Default Bearer are assigned ARP appropriate for MPS at the time of the establishment of the PDN connection for IMS, i.e. EPS Attach or PDN Connectivity Request.

The SPR may provide the following policy information related to an ASP (see clause 6.1.16):

- The ASP identifier;

- A transfer policy together with a reference ID, the volume of data to be transferred per UE, the expected amount of UEs and the network area information.

6.2.8   User Data Repository (UDR)

The UDR is a functional entity that acts as a single logical repository storing user data. As such it may contain all subscriber/subscription related information needed by the PCRF. In deployment scenarios where the UDR is used it replaces the SPR. The UDR provides a unique reference point to fetch these subscriber/subscription data. This reference point is named Ud. More information on the UDR can be found in TS 23.335 [25].

The SPR data listed in clause 6.2.4 are stored in the UDR, the information model remains unspecified.

84.   The Accused Instrumentalities receive a billing profile for each of said plurality of devices. AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[73] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data

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[73] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[74] For customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[75] For customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[76]

85.   As discussed in paragraph 83, *supra,* receiving a billing profile for each of said plurality of devices is implemented in the access network of the AT&T Network, in part in conjunction with the PCF/PCRF. [77]

86.   The Accused Instrumentalities generate a prioritization list defining an order of said plurality of devices, based on said billing profiles and on a billing history for each of said plurality of devices. For instance, on information and belief, AT&T generates a prioritization list to determine which, if any, device will see a decrease in data speed based on, in part, the plan associated with the device (which is part of the "billing profile") and the amount and/or type of data transmitted under that plan (which is part of the "billing history"). On information and belief, whether a user's device will experience decreased data speeds depends on, in part, the billing profile (e.g., specific plan). AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[78] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing

[74] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[75] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[76] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[77] TS 23.203 at pp. 24, 32, 69-70, 76, 91-93.
[78] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

[79] For customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[80] For customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[81]

87.   For instance, generating a prioritization list defining an order of said plurality of devices, based on said billing profiles and on a billing history for each of said plurality of devices is implemented in the access network of the AT&T Network.[82]

6.1.6   Service (data flow) Prioritization and Conflict Handling

Service pre-emption priority enables the PCRF to resolve conflicts where the activation of all requested active PCC rules for services would result in a cumulative authorized QoS which exceeds the Subscribed Guaranteed bandwidth QoS.

For example, when supporting network controlled QoS, the PCRF may use the pre-emption priority of a service, the activation of which would cause the subscriber's authorized QoS to be exceeded. If this pre-emption priority is greater than that of any one or more active PCC rules, the PCRF can determine whether the deactivation of any one or more such rules would allow the higher pre-emption priority PCC rule to be activated whilst ensuring the resulting cumulative QoS does not exceed a subscriber's Subscribed Guaranteed Bandwidth QoS.

If such a determination can be made, the PCRF may resolve the conflict by deactivating those selected PCC rules with lower pre-emption priorities and accepting the higher priority service information from the AF. If such a determination cannot be made, the PCRF may reject the service information from the AF.

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[79] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[80] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[81] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[82] *See, e.g.,* TS 23.203 at pp. 47, 74-76, 88-89.

6.2.1.1   Input for PCC decisions

The PCRF shall accept input for PCC decision-making from the PCEF, the BBERF if present, the TDF if present, the SPR and if the AF is involved, from the AF, as well as the PCRF may use its own predefined information. These different nodes should provide as much information as possible to the PCRF. At the same time, the information below describes examples of the information provided. Depending on the particular scenario all the information may not be available or is already provided to the PCRF.

The PCEF and/or BBERF may provide the following information:

- Subscriber Identifier;

- The IMEI(SV) of the UE;

- IPv4 address of the UE;

- IPv6 network prefix assigned to the UE;

- NBIFOM Routing Rules (when NBIFOM as specified in TS 23.161 [43] applies);

- IP flow routing information (when IP flow mobility as specified in TS 23.261 [23] applies);

NOTE 1: IP flow routing information and NBIFOM Routing Rules are provided only by the PCEF.

- Change of usability of an Access (when NBIFOM as specified in TS 23.161 [43] applies);

- IP-CAN bearer attributes;

NOTE 2: If IP flow mobility as specified in TS 23.161 [43] or in TS 23.261 [23] applies, an IP-CAN session may be active over multiple accesses and thus some IP-CAN bearer attributes may have a different value depending on the access type;

- Request type (initial, modification, etc.);

- Type of IP-CAN (e.g. GPRS, etc.);

NOTE 3: The Type of IP-CAN parameter should allow extension to include new types of accesses.

- Location of the subscriber;

NOTE 4: See clause 6.1.4 for the description of this location information.

NOTE 5: Depending on the type of IP-CAN, the limited update rate for the location information at the PCEF may lead to a UE moving outside the area indicated in the detailed location information without notifying the PCEF.

The SPR may provide the following information for a subscriber, connecting to a specific PDN:

- Subscriber's allowed services, i.e. list of Service IDs;

- For each allowed service, a pre-emption priority;

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- Information on subscriber's allowed QoS, including:

- the Subscribed Guaranteed Bandwidth QoS;

- a list of QoS class identifiers together with the MBR limit and, for real-time QoS class identifiers, GBR limit.

- Subscriber's charging related information;

- Spending limits profile containing an indication that policy decisions depend on policy counters available at the OCS that has a spending limit associated with it and optionally the list of relevant policy counters.

- Subscriber category;

- Subscriber's usage monitoring related information;

- Subscriber's profile configuration;

- Sponsored data connectivity profiles;

- MPS EPS Priority, MPS Priority Level (See TS 23.401 [17] for more detail on MPS Subscription);

- IMS Signalling Priority.

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The RCAF, if involved, may provide the following information for a subscriber:

- Subscriber Identifier.

- Identifier of the eNB, E-UTRAN cell or Service Area serving the subscriber.

NOTE 10: Whether in case of E-UTRAN the eNB identifier or the ECGI are included in the RUCI is up to operator configuration in the RCAF.

NOTE 11: Depending on the RUCI reporting interval configured in the RCAF, a UE may move outside the area indicated without the RCAF immediately notifying the PCRF. The PCRF can avoid receiving information about the cell currently serving a UE from multiple sources (i.e. via the Np and the Gx interface) by deactivating reporting of the congested cell's identifier over Np. In case PCRF receives information about the cell currently serving a UE via Np and Gx, then the information received via Gx is expected to take precedence.

- APNs.

- Congestion level or an indication of the "no congestion" state.

In addition, the predefined information in the PCRF may contain additional rules based on charging policies in the network, whether the subscriber is in its home network or roaming, depending on the IP-CAN bearer attributes.

The QoS Class Identifier (see clause 6.3.1) in the PCC rule is derived by the PCRF from AF or SPR interaction if available. The input can be SDP information or other available application information, in line with operator policy.

The Allocation/Retention Priority in the PCC Rule is derived by the PCRF from AF or SPR interaction if available, in line with operator policy.

6.2.2.4   QoS control

The PCEF enforces the authorized QoS for an IP-CAN bearer according to the information received via the Gx interface and depending on the bearer establishment mode.

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Only the GBR per bearer is used for resource reservation (e.g. admission control in the RAN). The MBR (per PCC rule / per bearer) is used for rate policing.

For a UE-initiated IP-CAN bearer establishment or modification the PCEF receives the authorized QoS (QCI, ARP, GBR, MBR) for a bearer that the PCEF has identified for the PCRF. The PCEF shall enforce it which may lead to a downgrading or upgrading of the requested bearer QoS.

NOTE 1:   The MBR is an average value, which is measured over some time period. Services may generate media with variable bitrate. For example, TS 26.114 [45] describes the bitrate variations that may be generated for real-time conversational media in the MTSI service. The policing function in the PCEF should take such bitrate variations into account.

For a network initiated IP-CAN bearer establishment or modification the PCEF receives the authorized QoS per PCC rule (QCI, ARP, GBR, MBR). For GBR bearers the PCEF should set the bearer's GBR to the sum of the GBRs of all PCC rules that are active and bound to that GBR bearer. If a set of PCC Rules is subject to resource sharing as specified in clause 6.1.14 the PCEF should use, for each applicable direction, the highest GBR from the set of PCC Rules sharing resources as input for calculating the bearer's GBR. For GBR bearers the PCEF should set the bearer's MBR to the sum of the MBRs of all PCC rules that are active and bound to that GBR bearer. If a set of PCC Rules is subject to resource sharing as specified in clause 6.1.14 the PCEF may, for each applicable direction, use the highest MBR from the set of PCC Rules as input for calculating the bearer's MBR.

88.   The Accused Instrumentalities repeat the following limitations recited in claim 1 of the '813 Patent.

89.   The Accused Instrumentalities receive traffic profiles over said network resource for said plurality of devices. For instance, on information and belief, AT&T receives traffic profiles over its network which may be used to determine if the network is "congested." On information

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and belief, the received traffic profiles are used to determine if a cell site is congested and/or implement AT&T's network management functionality.

90.   The "AT&T network is a shared network, which means that the transmission links and other network resources used to provide broadband services are shared among AT&T's subscribers, as well as among the various services offered by AT&T."[83] Accordingly, congestion may occur "when a large number of customers in a concentrated area access the network at the same time or when some customers consume a very large amount of network capacity during busy periods, such as at stadium events, during peak usage times, or during planned network maintenance."[84] AT&T uses "network management practices and other tools to manage network resources for the benefit of all of our broadband customers, especially during periods when network demand exceeds available network resources (also known as 'congestion')."[85] AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[86] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[87] For customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[88] For customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[89]

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[83] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[84] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[85] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[86] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[87] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[88] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[89] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

91.   For instance, receiving traffic profiles over said network resource for said plurality of devices is implemented in the access network of the AT&T Network.[90]

It shall be possible with the PCC architecture, in real-time, to monitor the overall amount of resources that are consumed by a user and to control usage independently from charging mechanisms, the so-called usage monitoring control.

It shall be possible for the PCC architecture to provide application awareness even when there is no explicit service level signalling.

The PCC architecture shall support making policy decisions based on subscriber spending limits.

The PCC architecture shall support making policy decisions based on RAN user plane congestion status.

The PCC architecture shall support making policy decisions for multi-access IP flow mobility solution described in TS 23.161 [43].

The PCC architecture shall support making policy decisions for (S)Gi-LAN traffic steering.

5.2.1   Rx reference point

The Rx reference point resides between the AF and the PCRF.

NOTE 1: The AF may be a third party application server.

This reference point enables transport of application level session information from AF to PCRF. Such information includes, but is not limited to:

-   IP filter information to identify the service data flow for policy control and/or differentiated charging;

-   Media/application bandwidth requirements for QoS control.

-   In addition, for sponsored data connectivity:

    -   the sponsor's identification,

    -   optionally, a usage threshold and whether the PCRF reports these events to the AF,

    -   information identifying the application service provider and application (e.g. SDFs, application identifier, etc.).

The Rx reference point enables the AF subscription to notifications on IP-CAN bearer level events (e.g. signalling path status of AF session) in the IP-CAN.

In order to mitigate RAN user plane congestion, the Rx reference point enables transport of the following information from the PCRF to the AF:

-   Re-try interval, which indicates when service delivery may be retried on Rx.

NOTE 2: Additionally, existing bandwidth limitation parameters on Rx interface during the Rx session establishment are available in order to mitigate RAN user plane congestion.

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[90] *See, e.g.,* TS 23.203 at 21, 31, 46, 75.

The SPR may provide the following policy information related to an ASP (see clause 6.1.16):

- The ASP identifier;
- A transfer policy together with a reference ID, the volume of data to be transferred per UE, the expected amount of UEs and the network area information.

The AF, if involved, may provide the following application session related information, e.g. based on SIP and SDP:

- Subscriber Identifier;
- IP address of the UE;
- Media Type;
- Media Format, e.g. media format sub-field of the media announcement and all other parameter information (a= lines) associated with the media format;
- Bandwidth;
- Sponsored data connectivity information (see clause 5.2.1);
- Flow description, e.g. source and destination IP address and port numbers and the protocol;
- AF application identifier;
- AF Communication Service Identifier (e.g. IMS Communication Service Identifier), UE provided via AF;
- AF Application Event Identifier;
- AF Record Information;
- Flow status (for gating decision);
- Priority indicator, which may be used by the PCRF to guarantee service for an application session of a higher relative priority;

NOTE 8:   The AF Priority information represents session/application priority and is separate from the MPS EPS Priority indicator.

92.   The Accused Instrumentalities manage said network resource according to said service profile and said billing profile if said network resource is fully utilized by said traffic profiles. For example, on information and belief, the shared network resource (e.g., a cell site) will deliver data according to the service profile and billing profile—which depends on, in part, the customer's priority and whether the resource is congested.

93.   For instance, on the AT&T Network congestion may occur "when a large number of customers in a concentrated area access the network at the same time or when some customers consume a very large amount of network capacity during busy periods, such as at stadium events, during peak usage times, or during planned network maintenance."[91] AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[92] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they

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[91] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[92] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[93] The mobile services provided by AT&T may be affected by a number of factors including "the capacity of the cell cite" being utilized by a user, "the number of other users connected to the same cell site and the services they are using," and the "applicable network management practices."[94] For customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[95] For customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[96] AT&T states that "[r]educed data throughput speeds mean [a user] may experience reduced data speeds and increased latency, which may cause websites to load more slowly and affect the performance of data-heavy activities such as video streaming."[97] Such "reduced data speeds" apply "when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site."[98]

94.   For instance, managing said network resource according to said service profile and said billing profile if said network resource is fully utilized by said traffic profiles is implemented in the access network of the AT&T Network.[99]

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[93] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[94] https://about.att.com/sites/broadband/performance (last visited Oct. 14, 2021).
[95] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[96] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[97] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[98] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[99] *See, e.g.,* TS 23.203 at 18, 21, 27, 28, 60; *see also* 3GPP TS 23.401 at 82-83, 96-97.

It shall be possible with the PCC architecture, in real-time, to monitor the overall amount of resources that are consumed by a user and to control usage independently from charging mechanisms, the so-called usage monitoring control.

It shall be possible for the PCC architecture to provide application awareness even when there is no explicit service level signalling.

The PCC architecture shall support making policy decisions based on subscriber spending limits.

The PCC architecture shall support making policy decisions based on RAN user plane congestion status.

The PCC architecture shall support making policy decisions for multi-access IP flow mobility solution described in TS 23.161 [43].

The PCC architecture shall support making policy decisions for (S)Gi-LAN traffic steering.

RAN user plane congestion: RAN user plane congestion occurs when the demand for RAN resources exceeds the available RAN capacity to deliver the user data for a prolonged period of time.

NOTE 1:   Short-duration traffic bursts is a normal condition at any traffic load level, and is not considered to be RAN user plane congestion. Likewise, a high-level of utilization of RAN resources (based on operator configuration) is considered a normal mode of operation and might not be RAN user plane congestion.

4.6   RAN user plane congestion detection, reporting and mitigation

It shall be possible to transfer RAN user plane congestion information from the RAN to the Core Network in order to mitigate the congestion by measures selected by the PCRF and applied by the PCEF/TDF/AF. The detailed description of this functionality can be found in TS 23.401 [17] and TS 23.060 [12].

The PCRF can receive RAN User Plane Congestion Information from the RAN Congestion Awareness Function (RCAF).

The PCC architecture extends the architecture of an IP-CAN, where the Policy and Charging Enforcement Function is a functional entity in the Gateway node implementing the IP access to the PDN. The allocation of the Bearer Binding and Event Reporting Function is specific to each IP-CAN type and specified in the corresponding Annex.

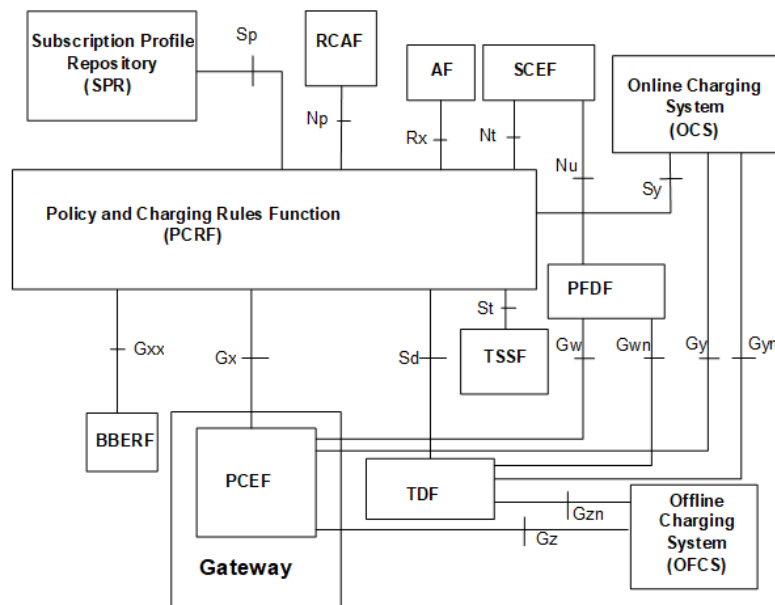The non-3GPP network relation to the PLMN is the same as defined in TS 23.402 [18].

Figure 5.1-1: Overall PCC logical architecture (non-roaming) when SPR is used

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6.1.15   Reporting of RAN user plane congestion information

6.1.15.1   General

RAN User Plane Congestion Information (RUCI) is reported to the PCRF to enable the PCRF to take the RAN user plane congestion status into account for policy decisions.

The RUCI includes the following information:

-    The IMSI identifying the UE impacted by congestion;

-    eNB identifier, ECGI or SAI identifying the eNB, E-UTRAN cell or Service Area, respectively, serving the UE.

NOTE: Whether in case of E-UTRAN the eNB identifier or the ECGI is included in the RUCI is up to operator configuration in the RCAF.

-    APN for which congestion information is reported;

-    Congestion level or an indication of the "no congestion" state.

6.1.15.2   Reporting restrictions

Depending on the operator's congestion mitigation policy, it may not be necessary to have RUCI reporting for all users. An operator shall be able to specify restrictions for RUCI reporting on a per UE per APN basis. Reporting restrictions can be used to activate or deactivate the RUCI reporting. Reporting restrictions can also be used to limit RUCI reporting. This is achieved by defining one or more sets of congestion levels, such that the RCAF indicates only that the UE experiences a congestion level within the given set but does not indicate the congestion level itself within that set. The sets must be non-overlapping such that a congestion level belongs to a single set only. Reporting restrictions can also be used to deactivate reporting of the congested cell's identifier as part of the RUCI.

NOTE: The support for the reporting restrictions is optional, and used only if both the PCRF and the RCAF support this feature.

6.1.15.3   UE mobility between RCAFs

A RCAF is assumed to serve a geographical area. A UE may move from the area handled by one RCAF to an area handled by a different RCAF. RCAF nodes cannot detect mobility by themselves: an RCAF node cannot differentiate whether a UE that is no longer affected by congestion has moved to another RCAF or not. When a given RCAF indicates no congestion to the PCRF for a given UE on the Np interface, this should be interpreted as no congestion experienced at the given RCAF which does not exclude that another RCAF may report that the same UE experiences congestion.

Consistent operation for UE mobility is ensured by applying the following rules at the PCRF.

-    The PCRF maintains the RCAF which has last indicated that the UE is affected by congestion.

-    When a new RCAF indicates that the UE is affected by congestion, the PCRF sends a message to the old RCAF to explicitly release context at the old RCAF.

4.3.24   RAN user plane congestion management function

4.3.24.1   General

The user plane congestion management function addresses how the system can effectively mitigate RAN user plane congestion in order to reduce the negative impact on the perceived service quality. The congestion mitigation measures include traffic prioritization, traffic reduction and limitation of traffic, and shall be able to manage user plane traffic across a range of variables including the user's subscription, the type of application, and the type of content. Congestion mitigation can be performed in the RAN or in the CN, or in a combined way both in the RAN and in the CN.

4.3.24.3   RAN user plane congestion mitigation in the CN

RAN user plane congestion mitigation in the CN uses RAN OAM information, collected by the RAN Congestion Awareness Function (RCAF), to detect congestion. The RAN Congestion Awareness Function is further described in clause 4.4.12. This functionality is applicable only in the case of UTRAN/E-UTRAN accesses.

NOTE 1:   The criteria used for detection of RAN user plane congestion (including detection of congestion abatement) are outside the scope of 3GPP specifications.

NOTE 2:   The interface to the RAN's OAM system is not standardized.

The RCAF can transfer RAN user plane congestion information (RUCI) to the PCRF over the Np reference point in order to mitigate the congestion by measures selected by the PCRF, as specified in TS 23.203 [6]. Decisions to apply congestion mitigation measures may take into account operator policies and subscriber information and all additional available IP-CAN session information.

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4.4.12 RAN Congestion Awareness Function

The RAN Congestion Awareness Function (RCAF) is an element that provides RAN User Plane Congestion Information (RUCI) to the PCRF to enable the PCRF to take the RAN user plane congestion status into account for policy decisions.

The RCAF collects information related to user plane congestion from the RAN's OAM system based on which the RCAF determines the congestion level (and the identifier) of an eNodeB or E-UTRAN cell.

ETSI

3GPP TS 23.401 version 16.10.0 Release 16   97   ETSI TS 123 401 V16.10.0 (2021-04)

Via the Nq interface the RCAF determines the UEs served by a congested eNodeB or congested E-UTRAN cell and retrieves the APNs of the active PDN connections of those UEs. The decision whether the RCAF operates on eNodeB or E-UTRAN cell level is up to operator configuration.

Via the Np reference point, the RCAF sends the RUCI to the PCRFs serving the UEs' PDN connections.

95.   On information and belief, the Accused Instrumentalities select at least one of said devices based on said prioritization list. In certain instances, the data rate for the selected device may be reduced. For example, the user(s) experiencing temporary lower data speeds will be selected based on, in part, their data plan and how much data they have used. AT&T engages in "congestion-based data management" whereby "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[100] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[101] For instance, with respect to customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[102] Moreover, with respect to customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[103]

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[100] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[101] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[102] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[103] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

96.   On information and belief, the Accused Instrumentalities dynamically modify at least one of said service profile and said billing profile for said selected devices, if said network resource is under-utilized by said traffic profile or if said network resource would be over-utilized by said traffic profiles. For example, on the AT&T Network congestion may occur "when a large number of customers in a concentrated area access the network at the same time or when some customers consume a very large amount of network capacity during busy periods, such as at stadium events, during peak usage times, or during planned network maintenance."[104] Accordingly, on the AT&T Network "during periods of congestion [certain customers] may experience reduced data speeds and increased latency as compared to other customers using the same cell site."[105] Moreover, depending "on the customer's AT&T Unlimited Data Plan, they will either always experience Congestion-based Data Management or experience it only after they have used a set amount of data in a billing period as outlined in their AT&T Unlimited Data Plan (for example, 22GB or 50GB of data in a billing period)."[106] The AT&T network management practice "adjusts dynamically to address the amount of congestion, which can start and stop over a very short time period."[107] Accordingly, "[b]ecause the amount of congestion at a cell site can vary significantly, the performance impact for affected AT&T Unlimited Data Plan customers may also vary significantly."[108] For instance, with respect to customers on its "AT&T Unlimited Starter" plan, AT&T "may temporarily slow data speeds if the network is busy."[109] Moreover, with respect

[104] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[105] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[106] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[107] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[108] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[109] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).

to customers on its "AT&T Unlimited Extra" plan, "[a]fter 50 GB, AT&T may temporarily slow data speeds if the network is busy."[110]

97.   For instance, dynamically modifying at least one of said service profile and said billing profile for said selected devices, if said network resource is under-utilized by said traffic profile or if said network resource would be over-utilized by said traffic profiles is implemented in the access network of the AT&T Network.[111]

dynamic PCC Rule: a PCC rule, for which the definition is provided to the PCEF via the Gx reference point.

policy control: The process whereby the PCRF indicates to the PCEF how to control the IP-CAN bearer. Policy control includes QoS control and/or gating control.

QoS class identifier (QCI): A scalar that is used as a reference to a specific packet forwarding behaviour (e.g. packet loss rate, packet delay budget) to be provided to a SDF. This may be implemented in the access network by the QCI referencing node specific parameters that control packet forwarding treatment (e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration, etc.), that have been pre-configured by the operator at a specific node(s) (e.g. eNodeB).

spending limit: A spending limit is the usage limit of a policy counter (e.g. monetary, volume, duration) that a subscriber is allowed to consume.

spending limit report: a notification, containing the current policy counter status generated from the OCS to the PCRF via the Sy reference point.

subscribed guaranteed bandwidth QoS: The per subscriber, authorized cumulative guaranteed bandwidth QoS which is provided by the SPR/UDR to the PCRF.

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[110] https://www.att.com/plans/unlimited-data-plans/ (last visited Oct. 14, 2021).
[111] *See, e.g.,* TS 23.203 at 17-18, 20-21, 25, 31-32, 42-43, 45, 47, 69.

4   High level requirements

4.1   General requirements

It shall be possible for the PCC architecture to base decisions upon subscription information.

It shall be possible to apply policy and charging control to any kind of 3GPP IP-CAN and any non-3GPP accesses connected via EPC complying with TS 23.402 [18]. Applicability of PCC to other IP-CANs is not restricted. However, it shall be possible for the PCC architecture to base decisions upon the type of IP-CAN used (e.g. GPRS, etc.).

The policy and charging control shall be possible in the roaming and local breakout scenarios defined in TS 23.401 [17] and TS 23.402 [18].

The PCC architecture shall discard packets that don't match any service data flow of the active PCC rules. It shall also be possible for the operator to define PCC rules, with wild-carded service data flow filters, to allow for the passage and charging for packets that do not match any service data flow template of any other active PCC rules.

The PCC architecture shall allow the charging control to be applied on a per service data flow and on a per application basis, independent of the policy control.

The PCC architecture shall have a binding method that allows the unique association between service data flows and their IP-CAN bearer.

A single service data flow detection shall suffice for the purpose of both policy control and flow based charging.

A PCC rule may be predefined or dynamically provisioned at establishment and during the lifetime of an IP-CAN session. The latter is referred to as a dynamic PCC rule.

The number of real-time PCC interactions shall be minimized although not significantly increasing the overall system reaction time. This requires optimized interfaces between the PCC nodes.

It shall be possible to take a PCC rule into service, and out of service, at a specific time of day, without any PCC interaction at that point in time.

It shall be possible to take APN-related policy information into service, and out of service, once validity conditions specified as part of the APN-related policy information are fulfilled or not fulfilled anymore, respectively, without any PCC interaction at that point in time.

PCC shall be enabled on a per PDN basis (represented by an access point and the configured range of IP addresses) at the PCEF. It shall be possible for the operator to configure the PCC architecture to perform charging control, policy control or both for a PDN access.

PCC shall support roaming users.

The PCC architecture shall allow the resolution of conflicts which would otherwise cause a subscriber's Subscribed Guaranteed Bandwidth QoS to be exceeded.

The PCC architecture shall support topology hiding.

It should be possible to use PCC architecture for handling IMS-based emergency service.

It shall be possible with the PCC architecture, in real-time, to monitor the overall amount of resources that are consumed by a user and to control usage independently from charging mechanisms, the so-called usage monitoring control.

It shall be possible for the PCC architecture to provide application awareness even when there is no explicit service level signalling.

The PCC architecture shall support making policy decisions based on subscriber spending limits.

The PCC architecture shall support making policy decisions based on RAN user plane congestion status.

The PCC architecture shall support making policy decisions for multi-access IP flow mobility solution described in TS 23.161 [43].

The PCC architecture shall support making policy decisions for (S)Gi-LAN traffic steering.

4.4   Usage Monitoring Control

It shall be possible to apply usage monitoring for the accumulated usage of network resources on a per IP-CAN session and user basis. This capability is required for enforcing dynamic policy decisions based on the total network usage in real-time.

The PCRF that uses usage monitoring for making dynamic policy decisions shall set and send the applicable thresholds to the PCEF or TDF for monitoring. The usage monitoring thresholds shall be based either on time, or on volume. The PCRF may send both thresholds to the PCEF or TDF. The PCEF or TDF shall notify the PCRF when a threshold is reached and report the accumulated usage since the last report for usage monitoring. If both time and volume thresholds were provided to the PCEF or TDF, the accumulated usage since last report shall be reported when either the time or the volume thresholds are reached.

NOTE: There are reasons other than reaching a threshold that may cause the PCEF/TDF to report accumulated usage to the PCRF as defined in clauses 6.2.2.3 and 6.6.2.

The usage monitoring capability shall be possible for an individual or a group of service data flow(s), or for all traffic of an IP-CAN session in the PCEF. When usage monitoring for all traffic of an IP-CAN session is enabled, it shall be possible to exclude an individual SDF or a group of service data flow(s) from the usage monitoring for all traffic of this IP-CAN session. It shall be possible to activate usage monitoring both to service data flows associated with predefined PCC rules and dynamic PCC rules, including rules with deferred activation and/or deactivation times while those rules are active.

5.2.2   Gx reference point

The Gx reference point resides between the PCEF and the PCRF.

The Gx reference point enables the PCRF to have dynamic control over the PCC behaviour at a PCEF.

The Gx reference point enables the signalling of PCC decision, which governs the PCC behaviour, and it supports the following functions:

- Establishment of Gx session (corresponding to an IP-CAN session) by the PCEF;

- Request for PCC decision from the PCEF to the PCRF;

- Provision of IP flow mobility routing information from PCEF to PCRF; this applies only when IP flow mobility as defined in TS 23.261 [23] is supported;

- Provision of PCC decision from the PCRF to the PCEF;

- Reporting of the start and the stop of detected applications and transfer of service data flow descriptions and application instance identifiers for detected applications from the PCEF to the PCRF;

- Reporting of the accumulated usage of network resources on a per IP-CAN session basis from the PCEF to the PCRF;

- Delivery of IP-CAN session specific parameters from the PCEF to the PCRF or, if Gxx is deployed, from the PCRF to the PCEF per corresponding request;

- Negotiation of IP-CAN bearer establishment mode (UE-only or UE/NW);

- Termination of Gx session (corresponding to an IP-CAN session) by the PCEF or the PCRF.

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NOTE: The PCRF decision to terminate a Gx session is based on operator policies. It should only occur in rare situations (e.g. the removal of a UE subscription) to avoid service interruption due to the termination of the IP-CAN session.

The information contained in a PCC rule is defined in clause 6.3.

6.1.4   Event Triggers

The Event Reporting Function (ERF) performs event trigger detection. When an event matching the event trigger occurs, the ERF shall report the occurred event to the PCRF. The Event Reporting Function is located either at the PCEF or, at the BBERF (if applicable) or, at the TDF for solicited application reporting (if applicable).

The event triggers define the conditions when the ERF shall interact again with PCRF after an IP-CAN session establishment. The event triggers that are required in procedures shall be unconditionally reported from the ERF, while the PCRF may subscribe to the remaining events. Whether an event trigger requires a subscription by the PCRF is indicated in column 4 in table 6.2 below.

The PCRF subscribes to new event triggers or remove armed event triggers unsolicited at any time or upon receiving a request from the AF, an event report or rule request from the ERF (PCEF or BBERF or TDF) using the Provision of PCC Rules procedure or the Provision of QoS Rules procedure (if applicable) or the Provision of ADC Rules procedure (if applicable). If the provided event triggers are associated with certain parameter values then the ERF shall include those values in the response back to the PCRF. Event triggers are associated with all rules at the ERF of an IP-CAN session (ERF is located at PCEF) or Gateway Control session (ERF is located at BBERF) or with Traffic Detection session (ERF is located in TDF). Event triggers determine when the ERF shall signal to the PCRF that an IP-CAN bearer has been modified. It shall be possible for the ERF to react on the event triggers listed in table 6.2.

Table 6.2: Event triggers

Event trigger	Description	Reported from	Condition for reporting
PLMN change	The UE has moved to another operators' domain.	PCEF	PCRF
QoS change	The QoS of the IP-CAN bearer has changed (note 3).	PCEF, BBERF	PCRF
QoS change exceeding authorization	The QoS of the IP-CAN bearer has changed and exceeds the authorized QoS (note 3).	PCEF	PCRF
Traffic mapping information change	The traffic mapping information of the IP-CAN bearer has changed (note 3).	PCEF	Always set
Resource modification request	A request for resource modification has been received by the BBERF/PCEF (note 6).	PCEF, BBERF	Always set
Routing information change	The IP flow mobility routing information has changed (when IP flow mobility as specified in TS 23.261 [23] applies) or the PCEF has received Routing Rules from the UE (when NBIFOM as specified in TS 23.161 [43] applies) (note 11) (note 16).	PCEF	Always set (note 15)
Change in type of IP-CAN (see note 1)	The access type of the IP-CAN bearer has changed.	PCEF	PCRF
Loss/recovery of transmission resources	The IP-CAN transmission resources are no longer usable/again usable.	PCEF, BBERF	PCRF
Location change (serving cell) (see note 10)	The serving cell of the UE has changed.	PCEF, BBERF	PCRF
Location change (serving area) (see notes 4 and 10)	The serving area of the UE has changed.	PCEF, BBERF	PCRF
Location change (serving CN node) (see notes 5 and 10)	The serving core network node of the UE has changed.	PCEF, BBERF	PCRF
Change of UE presence in Presence Reporting Area (see note 17)	The UE is entering/leaving a Presence Reporting Area	PCEF, BBERF	PCRF
Out of credit	Credit is no longer available.	PCEF, TDF	PCRF
Enforced PCC rule request	PCEF is performing a PCC rules request as instructed by the PCRF.	PCEF	PCRF
Enforced ADC rule request	TDF is performing an ADC rules request as instructed by the PCRF.	TDF	PCRF
UE IP address change (see note 9)	A UE IP address has been allocated/released	PCEF	Always set
Access Network Charging Correlation Information	Access Network Charging Correlation Information has been assigned.	PCEF	PCRF
Usage report (see note 7)	The IP-CAN session or the Monitoring key specific resources consumed by a UE either reached the threshold or needs to be reported for other reasons.	PCEF, TDF	PCRF

To activate usage monitoring, the PCRF shall set the Usage report event trigger and provide applicable usage thresholds for the Monitoring key(s) that are subject to usage monitoring in the requested node (PCEF or TDF, solicited application reporting). The PCRF shall not remove the Usage report event trigger while usage monitoring is still active in the PCEF/TDF.

If the Usage report event trigger is set and the volume or the time thresholds, earlier provided by the PCRF, are reached, the PCEF or TDF (whichever received the event trigger) shall report this event to the PCRF. If both volume and time thresholds were provided and the thresholds, for one of the measurements, are reached, the PCEF or TDF shall report this event to the PCRF and the accumulated usage since last report shall be reported for both measurements.

The enforcement of the authorized QoS of the IP-CAN bearer may lead to a downgrading or upgrading of the requested bearer QoS by the GW (PCEF) as part of a UE-initiated IP-CAN bearer establishment or modification. Alternatively, the enforcement of the authorised QoS may, depending on operator policy and network capabilities, lead to network initiated IP-CAN bearer establishment or modification. If the PCRF provides authorized QoS for both, the IP-CAN bearer and PCC rule(s), the enforcement of authorized QoS of the individual PCC rules shall take place first.

QoS authorization information may be dynamically provisioned by the PCRF or, if the conditions mentioned in clause 6.3.1 apply, it can be a predefined PCC rule in the PCEF. In case the PCRF provides PCC rules dynamically, authorised QoS information for the IP-CAN bearer (combined QoS) may be provided. For a predefined PCC rules within the PCEF the authorized QoS information shall take affect when the PCC rule is activated. The PCEF shall combine the different sets of authorized QoS information, i.e. the information received from the PCRF and the information corresponding to the predefined PCC rules. The PCRF shall know the authorized QoS information of the predefined PCC rules and shall take this information into account when activating them. This ensures that the combined authorized QoS of a set of PCC rules that are activated by the PCRF is within the limitations given by the subscription and operator policies regardless of whether these PCC rules are dynamically provided, predefined or both.

The PCRF shall decide how certain service/application traffic shall be treated in the PCEF and in the TDF, if applicable, and ensure that the PCEF user plane traffic mapping and treatment is in accordance with the user's subscription profile.

If Gxx applies, the PCRF shall provide QoS rules with identical service data flow templates as provided to the PCEF in the PCC rules. If the service data flow is tunnelled at the BBERF, the PCRF shall provide the BBERF with information received from the PCEF to enable the service data flow detection in the mobility tunnel at the BBERF. In case 2a, defined in clause 7.1, the PCRF may also provide to the BBERF the charging ID information received from the PCEF. If IP flow mobility as specified in TS 23.261 [23] applies, the PCRF shall, based on IP flow mobility routing rules received from the PCEF, provide the authorized QoS rules to the applicable BBERF as specified in clause 6.1.1.3.

The PCRF should for an IP-CAN session derive, from IP-CAN specific restrictions, operator policy and SPR data, the list of permitted QoS class identifiers and associated GBR and MBR limits for the IP-CAN session.

The PCRF may check that the service information provided by the AF is consistent with both the operator defined policy rules and the related subscription information as received from the SPR during IP-CAN session establishment before storing the service information. The service information shall be used to derive the QoS for the service. The PCRF may reject the request received from the AF when the service information is not consistent with either the related subscription information or the operator defined policy rules and as a result the PCRF shall indicate that this service information is not covered by the subscription information or by operator defined policy rules and may indicate, in the response to the AF, the service information that can be accepted by the PCRF (e.g. the acceptable bandwidth). In the absence of other policy control mechanisms outside the scope of PCC, it is recommended that the PCRF include this information in the response.

98.   The Accused Instrumentalities repeat the recited claim limitations until said

plurality of devices no longer continue to share said network resource. For instance, on the AT&T

Network, once "the congestion at the cell site abates, or if the customer's session migrates to an

uncongested cell site, speeds and latency are not affected."[112] This network management practice

utilized by AT&T "adjusts dynamically to address the amount of congestion, which can start and

stop over a very short time period."[113] AT&T states that "[r]educed data throughput speeds mean

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[112] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[113] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

[a user] may experience reduced data speeds and increased latency, which may cause websites to load more slowly and affect the performance of data-heavy activities such as video streaming."[114] Such "reduced data speeds" apply "when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site."[115] On the AT&T Network, "[s]tandard speeds will resume once the cell site is no longer congested or when your data session moves to an uncongested cell site, and speeds will no longer be reduced during periods of network congestion at the start of your next billing period, unless your usage again exceeds an applicable, identified data usage threshold for that next billing period."[116]

[117]

6.2.1.2   Subscription information management in the PCRF

The PCRF may request subscription information from the SPR for an IP-CAN session at establishment or a gateway control session at establishment. The subscription information may include user profile configuration indicating whether application detection and control should be enabled. The PCRF should specify the subscriber ID and, if available, the PDN identifier in the request. The PCRF should retain the subscription information that is relevant for PCC decisions until the IP-CAN session termination and the gateway control session termination.

The PCRF may request notifications from the SPR on changes in the subscription information. Upon reception of a notification, the PCRF shall make the PCC decisions necessary to accommodate the change in the subscription and updates the PCEF and/or the BBERF and/or the TDF by providing the new PCC and/or QoS and/or ADC decisions if needed. The PCRF shall send a cancellation notification request to the SPR when the related subscription information has been deleted.

100.   On information and belief, the Accused Instrumentalities clear said prioritization list when said plurality of devices are no longer sharing said network resource. For instance, on the AT&T Network, once "the congestion at the cell site abates, or if the customer's session migrates to an uncongested cell site, speeds and latency are not affected."[118] This network

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[114] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[115] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[116] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[117] *See, e.g.,* TS 23.203 at 76.
[118] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).

management practice utilized by AT&T "adjusts dynamically to address the amount of congestion, which can start and stop over a very short time period."[119] AT&T states that "[r]educed data throughput speeds mean [a user] may experience reduced data speeds and increased latency, which may cause websites to load more slowly and affect the performance of data-heavy activities such as video streaming."[120] Such "reduced data speeds" apply "when using Data Services at times and in areas experiencing network congestion compared to other customers using the same cell site."[121] On the AT&T Network, "[s]tandard speeds will resume once the cell site is no longer congested or when your data session moves to an uncongested cell site, and speeds will no longer be reduced during periods of network congestion at the start of your next billing period, unless your usage again exceeds an applicable, identified data usage threshold for that next billing period."[122]

[123]

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The PCRF may request notifications from the SPR on changes in the subscription information. Upon reception of a notification, the PCRF shall make the PCC decisions necessary to accommodate the change in the subscription and updates the PCEF and/or the BBERF and/or the TDF by providing the new PCC and/or QoS and/or ADC decisions if needed. The PCRF shall send a cancellation notification request to the SPR when the related subscription information has been deleted.

102.   The acts of infringement by AT&T have caused damage to Plaintiff, and Plaintiff is entitled to recover from Defendants the damages sustained by Plaintiff as a result of Defendants'

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[119] https://about.att.com/sites/broadband/network (last visited Oct. 14, 2021).
[120] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[121] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[122] https://www.att.com/legal/terms.consumerServiceAgreement.html (last visited Oct. 14, 2021).
[123] *See, e.g.,* TS 23.203 at 76.

wrongful acts in an amount subject to proof at trial. The infringement of the '813 Patent by AT&T

has damaged and will continue to damage Plaintiff.

JURY DEMAND

103.   Plaintiff hereby demands a trial by jury on all issues.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff requests entry of judgment in its favor and against AT&T as

follows:

a. A declaration that AT&T has infringed and is infringing one or more claims of the '813

Patent, either literally or under the doctrine of equivalents;

b. An award of damages pursuant to 35 U.S.C. § 284 adequate to compensate TNS for

AT&T's infringement of the '813 Patent in an amount according to proof at trial

(together with prejudgment and post-judgment interest), but no less than a reasonable

royalty;

c. An award of costs and expenses pursuant to 35 U.S.C. § 284 or as otherwise permitted

by law; and

d. Such other and further relief, whether legal, equitable, or otherwise, to which Plaintiff

may be entitled or which this Court may order.

Dated: November 9, 2021

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/s/ *Amir Alavi* _____
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